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DEDICATED TO THE MEMORY OF

ANN HERRICK (WATERMAN) RUDOLPH (1934-1991) AND EMANUEL DAVID "RUDY" RUDOLPH (1927-1992)

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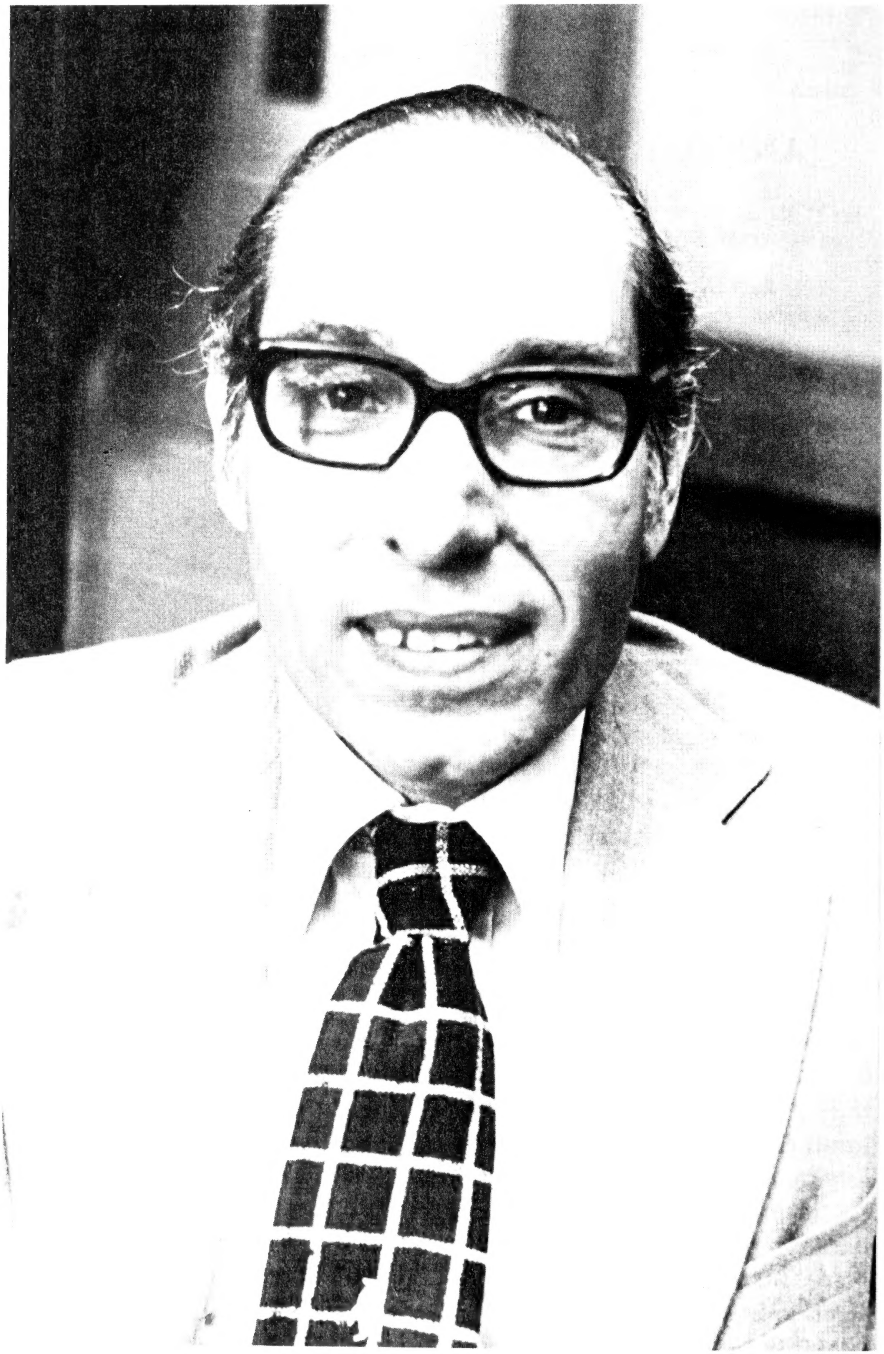
At times, because of death by accident or sudden illness, close friends' lives are gone long before their expected time. This unfortunate situation befell two trained botanists, Emanuel "Rudy" Rudolph, originally from Brooklyn, New York, and his wife Ann (Waterman) Rudolph of northern Michigan, whose careers after marriage developed in Columbus, Ohio. He became recognized for his research in the biology of lichens of the Antarctic continent and for his studies in the history of and popularization of botany, especially as taught to children. She combined her botanical knowledge with librarian talents to become a bibliographer for special ecologically oriented research projects at the Battelle Memorial Institute. Both of them were avid collectors, he mostly of natural history books, and she of buttons, in addition to baskets, paintings, and other items, all of which made their home a virtual museum. As friendly, hospitable people, they attracted many friends worldwide, many of whom were privileged to visit their fascinating home. The three papers published here pertain to (1) the development of their natural history library and Rudy's involvement with University Library affairs; (2) Ann's life with plants, books, and buttons; and, following their deaths, (3) the creation of a beautiful Rudolph Memorial reading room in the Herbarium Library of The Ohio State University, where their botanical books were deposited. A biographical account of E.D. Rudolph appears in another paper by Stuckey (1994).



EMANUEL D. RUDOLPH

EMANUEL DAVID RUDOLPH (1927–1992): BOOK COLLECTOR AND LIBRARY FRIEND[1]

Ronald L. Stuckey

Emanuel David Rudolph will be remembered as a most kind, generous, and modest gentleman, displaying good humor and good will (Fig. 1). He was a truly valued friend, respected colleague, and eminent scholar, who gave much thoughtful counsel to his friends and showed enthusiasm for life, science, and books. Even though a multiplicity of interests and projects occupied his time, Rudolph accomplished much in life through his finely tuned organizational skills conducted in a most calm, patient, unobtrusive, and efficient manner. To his friends, he was known affectionately as Rudy, a name given to him about 1962 by his wife Ann. For 37 years, he was a dedicated educator in botany, first at Wellesley College, Massachusetts, and then at The Ohio State University, Columbus. At age 64, Emanuel D. (Rudy) Rudolph died in University Hospital, Columbus, Ohio, on 22 June 1992, following a traffic accident of 19 June near Wooster, Ohio (Burk and Stuckey 1994; Kiss 1993; Meyer 1983; Stuckey 1993, 1994; Stuckey and Lipscomb 1992; White 1993).

Together for nearly 30 years, Ann W. and Emanuel D. Rudolph amassed an extensive, extraordinary personal library of more than 53,000 books (Fig. 2). Their home at 384 Arcadia Avenue in Columbus, Ohio, purchased in 1965, was a 1912, three–story, six–room sturdy red brick house (Fig. 2). It soon became too small for their actively growing library, which had reached

FIGURE 1. Emanuel David Rudolph (Left) From The Ohio State University, date unknown. (Right) Graduation photograph, Erasmus Hall High School, Brooklyn, New York, 1945.

[1] Presented as part of a symposium on "Botanical Libraries and Herbaria" at the Dedication of the Emanuel D. and Ann W. Rudolph Memorial Library Room, 21 May 1993, in the Herbarium at the Museum of Biological Diversity, The Ohio State University, 1315 Kinnear Road, Columbus, Ohio.

FIGURE 2. The Rudolph Home and Main Library Room at 384 Arcadia Avenue, Columbus, Ohio. (Above) Rudy and Ann in their main library room with the books on children's natural history on the shelves behind them, October 1983. Photograph by Ann Lubrecht. (Below) Outside view of the Rudolph House with the main house, closed–in front porch to the right, and the 1972 addition of the garage, main library room, and connecting room to the left, August 1992. Photograph by A. E. Spreitzer.

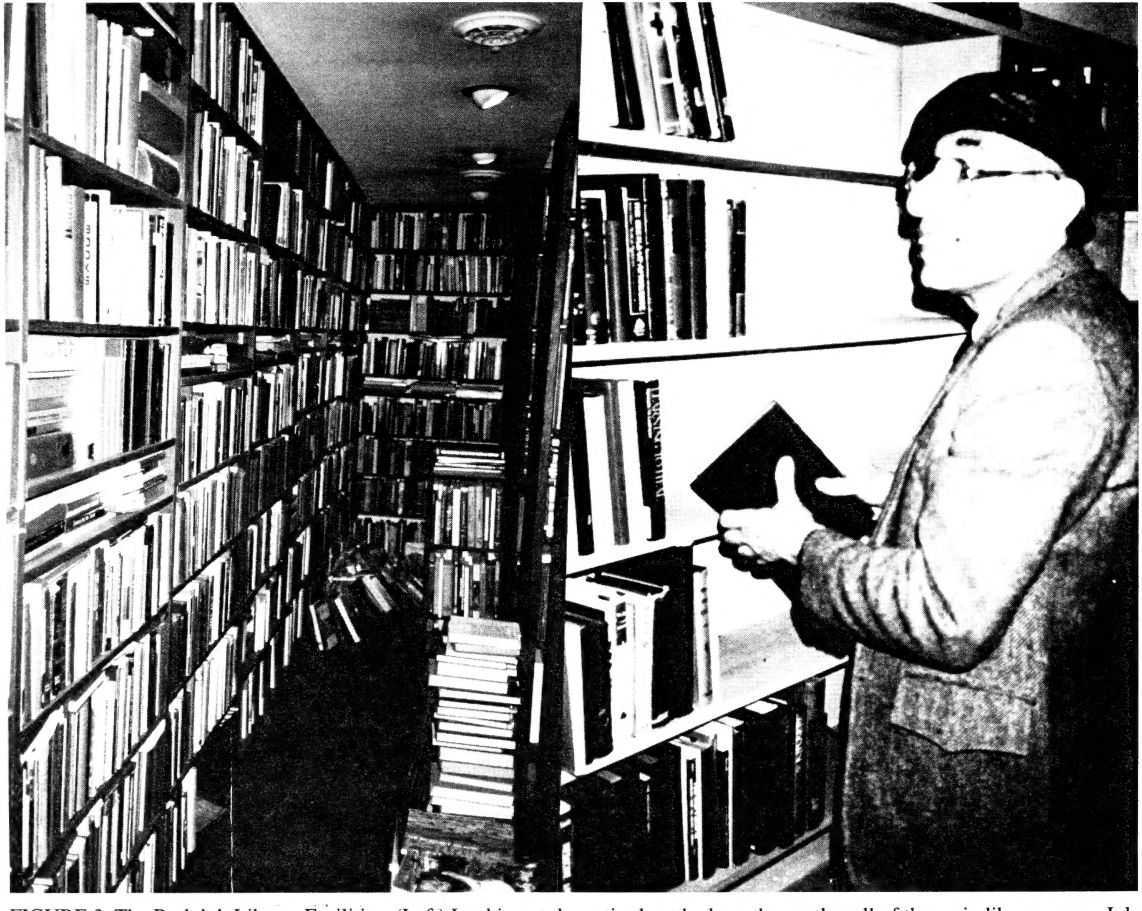


FIGURE 3. The Rudolph Library Facilities. (Left) Looking at the entire length along the south wall of the main library room, July 1992. Photograph by Ronald L. Stuckey. (Right) In the Indianola Avenue House, "the house just for books," with Rudy shelving medical books in the second story room above the back porch, 1991. Photograph by Ann Rudolph.

10,000 books by the early 1970's. To accommodate more books, they added a new large, adjacent special library room in 1972 (Figs. 2, 3). This room became the focus of their library holdings. The Rudolph library continued to expand as the decade of the 1980's arrived. The options considered were to add more rooms to their Arcadia home or to rent an apartment across the street to accommodate more books. When these options were no longer viable, in 1987 they purchased a second house (Fig. 3) on an adjacent property "just for books" (Carmen, 1987). At about this time the number of books totaled 43,000. Final library room expansion came in 1988, when they enclosed the open front porch of their Arcadia home for still more books (Fig. 4). The room that was dedicated 21 May 1993, located in the Herbarium of the Museum of Biological Diversity building on the campus of The Ohio State University, is patterned after the Rudolphs' special library room in their Arcadia Avenue home.

The largest portion of the Rudolph library consisted of books in botany, zoology, natural history, and polar science and exploration. Another major portion consisted of the largest and most diversified private collection of children's natural history books known in this country, in addition to a huge selection of general textbooks in natural science, biology, and botany (Fig. 4). The Rudolph library served many purposes. Not only was it available for Rudy's courses in botany and the history of biology and for his research on polar lichens and botanical history, but it was also a focal point for visits by student classes, entertainment of distinguished guests, and their own pastime enjoyment. The Rudolphs were truly exceptional ambassadors for the world of books (Rollins 1984).

BEGINNINGS OF THE RUDOLPH LIBRARY

At about age 12, Rudolph began taking an interest in reading books, as well as learning about birds and plants of the natural world. He began buying and collecting books while in high school. This activity carried on into Rudolph's college years while an undergraduate in biology at New York University (1947–1950) and as a graduate student in botany at Washington University (1951–1955), St. Louis, Missouri (Figs. 5, 6). Between classes at New York University, he would walk to Greenwich Village to purchase books in the second–hand book district, one block from campus. Initially his acquisitions were books in botany and natural history, including both basic and classic references concerned with cryptogamic plants and books about the polar regions. He obtained books from many sources—from new and used book stores while traveling throughout the country, book catalogues issued by publishers and second–hand bookdealers, and thrift, Good Will, and Salvation Army stores.

On numerous occasions, I drove Rudy in my car to a used book sale, as Ann would have their car, for example, either at Battelle Memorial Institute, where she was employed, or with her at a local button club meeting. Rudy had to arrive at least an hour before the sale began, so he could be among the first to enter when the doors were opened. He usually knew most of the people in line,

FIGURE 4. The Rudolph Library facilities at 384 Arcadia Avenue. (Above) Botanical books in the hallway on the second floor of the house, August 1992. Both photographs by A. E. Spreitzer. (Below) Mostly agricultural and economic botany books in the closed-in front porch room, August 1992. Photograph by Ronald L. Stuckey.

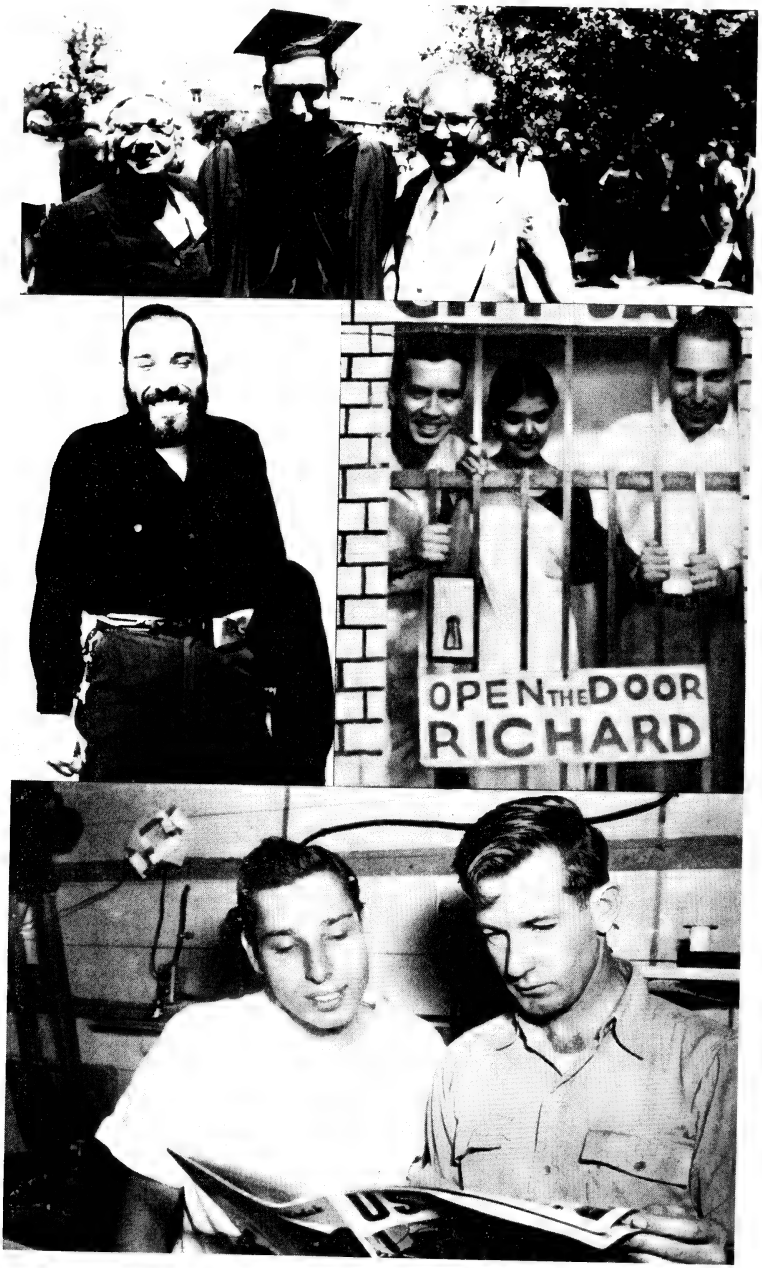


FIGURE 5. Emanuel D. Rudolph in early life. (Above) With his parents Jack and Sarah (Wolfe) Rudolph at Ph.D. graduation ceremonies, Washington University, St. Louis, Missouri, June 1955. (Middle Left) As an Antarctic Research Investigator for the Institute of Polar Studies, The Ohio State University. (Middle Right) With fellow graduate students in an amusement park, Brooklyn, New York, summer 1954. (Below) In the United States Army as a Medical Technician with Francis Elmore Bruns, General Hospital, Santa Fe, New Mexico, 1946.

FIGURE 6. Emanuel D. Rudolph in the 1950's. (Above) Excursion to hilltop prairie near Valmeyes, Illinois. Left to Right: Emanuel D. Rudolph, Robert Mohlenbrock, and Elianne Norman, 13 March 1955. Photograph by K. U. Kramer. (Below) Teaching a class in the field at Wellesley College, Massachusetts, 1959. Photographer unknown.

who also were book collecting enthusiasts or bookdealers, and various conversations about books would prevail. When the doors opened, he rushed, and sometimes ran, to be the first one at a particular favorite table covered with books. At large sales, I usually would not see him until a half–hour or more later, but he often would find something of interest for me. On many occasions after coming from a book-buying expedition, he would bring me books or pamphlets, especially on Ohioana, and no matter what the price, if only 25¢, I always paid him for them, as that seemed what he expected of me.

Upon obtaining the Ph.D. in Biology at Washington University in 1955 (Fig. 5), Rudolph was employed to teach in the Department of Botany, Wellesley College, where he remained from 1955 to 1961 (Fig. 6). His interests in libraries and book collecting continued, and he became involved in a co–operative project of the College Library and the Education Committee of the Wellesley Conservation Council. As a member of that committee, Rudolph participated in establishing a "Conservation Shelf" in the College Library, where books and papers on conservation topics would readily be seen and available to library patrons (Anonymous 1960).

Sometime before 1959, while at Wellesley College, he began building a collection of natural history books written for children. He wrote about this facet of his book collecting in the February 1979 issue of *Friends Line*, the newsletter of the Friends of the Libraries of The Ohio State University (Rudolph 1979). An unidentified colleague at Wellesley College, while preparing for retirement, presented him with a little book entitled, "The Child's Botany" (Anonymous 1831). With that acquisition, followed soon by the addition of other children's natural history books, Rudolph was hooked on building a library that grew to several thousand volumes solely about children and the literature written for children. His collection largely consisted of chap books, shape books, pop–up books, toy books, and animal alphabet books. While studying these children's books, Rudolph discovered how information about plants and animals was taught to children during the nineteenth and twentieth centuries. These discoveries led him into one of his main research themes, the history of the popularization of science involving the disciplines of natural history, biology, and botany. He published three papers as a result of studies with his children's book collection (Rudolph 1973a, b; 1978). Several other studies were left as abstracts and in manuscripts or were in progress toward being written.

Rudolph (1979) further wrote about what collecting books and acquiring a library meant to him.

> "Book collecting provides me with excitement, adventure, intellectual stimulation, and pleasure. The excitement and adventure come from searching out books that will be integral to the collection, and the intellectual stimulation from studying books that open windows to readers' and writers' minds. The more books the more windows and the greater the illumination. Pleasure comes from seeing the collection grow and mature and from examining books, some beautiful and made with care, and each, whether beautiful or not, showing individuality and personality. My books are a never ending source of pleasure."

PROFESSIONAL DEVELOPMENT

As a researcher, Rudolph's main interest was with lichens, but with heavy teaching responsibilities in botany courses at Wellesley College (Fig. 6), he had little time for investigations of these plants. With the help of friends, he was encouraged to relocate at The Ohio State University to participate in the Institute's Polar Research programs, and also to continue his teaching of botany to undergraduate students. By April of 1961, Rudolph accepted an appointment at The Ohio State University, with the priority to conduct research on cryptogamic plants, especially lichens in polar regions. He became a dedicated, highly motivated researcher, who was the first botanist to undertake extensive research on the vegetation of Antarctica during five field expeditions in the 1960's (Fig. 7). From those efforts, he became internationally recognized for his diverse experimental field studies toward understanding the total biology of lichens in both polar regions (Anonymous 1969, Meyer 1983). Later he also engaged in research on the effects of stress conditions such as cold, drought, and sulfur dioxide and other pollutants on the lichens and fungi of coal strip mine areas in Ohio (Stuckey 1994).

By the early 1960's, however, Rudolph's interests were moving in directions involving more projects with books. His own personal library was now growing much faster because his wife, Ann Waterman, whom he married 11 August 1962, was now a partner in this collecting venture. She kept the records for their library by typing bibliographic information for each book on a 3×5 index card. In addition, she recorded the number that Rudy assigned to each book, the date of purchase, from whom purchased, and the book's cost. This same information also was recorded in an accession book, of which a total of seven ledger books were completed. These accession books were presented by the executor of the Rudolph estate to the Rare Books and Manuscript Library at The Ohio State University 17 September 1992 (Fig. 8).

The growth of the Rudolph library can be viewed by comparing selected numbers of books with the month of the particular year when these numbers were attained. Inserted on a separate sheet in one of the accession books is a record of the number of volumes purchased per year, the annual cost of acquiring books, the total accumulated cost added for all previous years, and the annual cost per volume. The most books purchased in one year (1983) was 2,629, and the year with the fewest books (500) was 1966. The total number of dollars spent was $204,323 from the year 1964 through 1990, with the largest annual cost of $17,135 occurring in the year 1990, the last year for which information is available. The annual cost per volume rose through the years, reaching its highest value of $7.68 in 1990.

Rudolph's interest in the history of science began to develop in the early 1960's. He presented his first paper in that discipline to the plant sciences section at the annual meeting of The Ohio Academy of Science, held in April 1965 at Ohio University, Athens. His paper, although never published, discussed an overlooked American edition (1853) of Matthias Jacob Schleiden's book (1848, 1853) of public lectures on a very general approach to botany. From that begin-

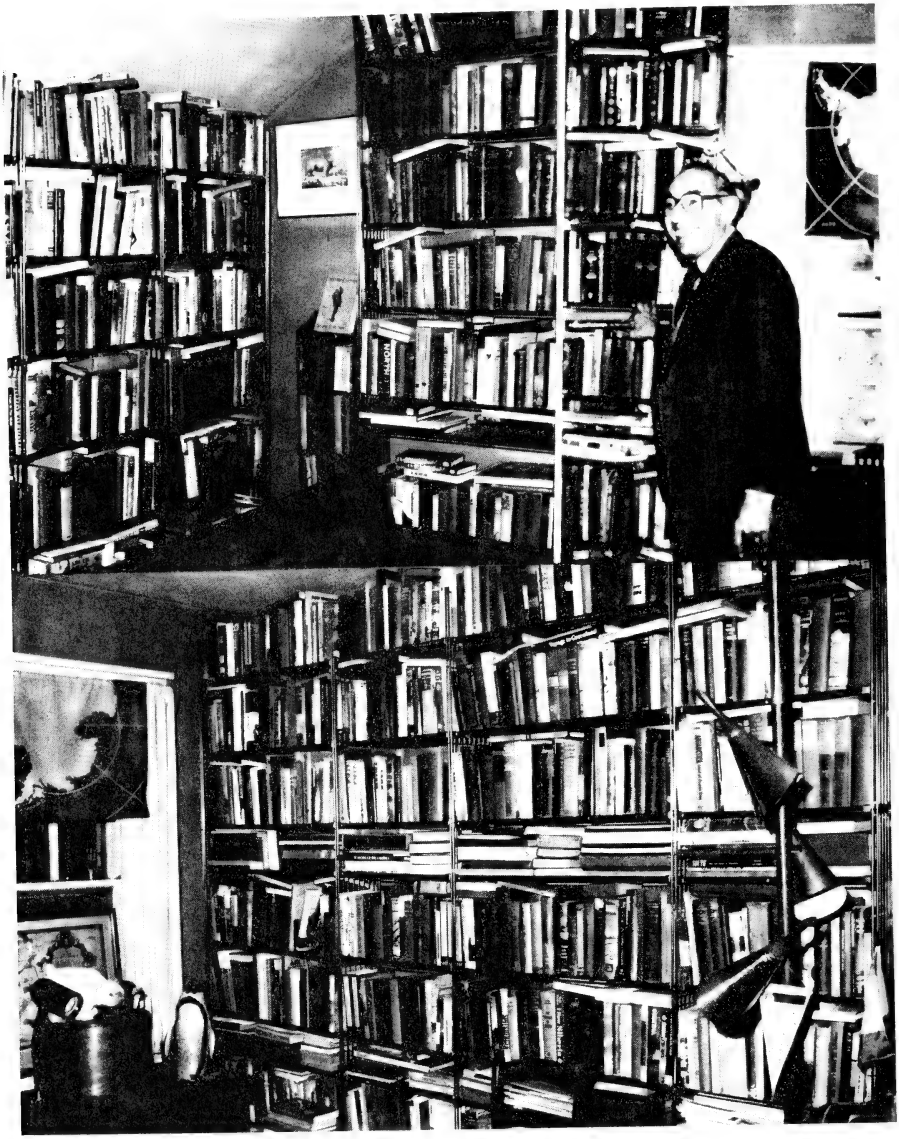


FIGURE 7. The room with polar books on the second floor of the Rudolph home at 384 Arcadia Avenue. (Above Left) Northwest corner of room. (Above Right) Rudy along north wall. (Below) Books along east wall with window on north wall, August 1992. Two photographs by A. E. Spreitzer. Photograph of Rudy, January 1988, photographer unknown.

FIGURE 8. Presentation of the seven ledger books containing the accession records of the Rudolphs' Library, 17 September 1992, in the Rare Books and Manuscripts Room, Main Library, OSU. In center of photograph, Ronald L. Stuckey, Executor of the Rudolph Estate; Librarians (Left to Right) Wesley Boomgaarden, preservation officer; Bruce Leach, biological sciences; William Studer, director; Geoffrey Smith, manuscripts; Gay Dannelly, development; Elizabeth Wheatley, Friends. Photograph with R.L. Stuckey camera.

ning onward, Rudolph's research focused more specifically on the history of biology and botany. He wrote and presented papers to other organizations holding meetings on the history of science. As manuscripts were completed, publications followed. Subsequently, Rudolph became known nationally for his broad interests in nineteenth century history of biology and botany. This recognition came because of his unprecedented studies of children's books as windows toward the understanding of the popularization of biology (Rudolph 1973a, b; 1978) and the role of women in the development of both popular and professional botany (Rudolph 1982, 1984, 1990).

EARLY INTEREST IN THE OSU LIBRARIES

By the mid 1960's, as noted from letters and memos retained in Rudolph's office files, he was making donations of travel maps, brochures, and books to The Ohio State University Libraries. In November, 1965, he wrote Richard A. Ploch, the Curator of the Rare Book and Special Collections, urging him to accept the archives of The Ohio Forestry Association. As supporting evidence,

Rudy pointed out that the University is the center of agricultural education and research in Ohio, and that these archival materials would provide original research materials for faculty, graduate students, and visiting scholars, not only in agriculture, but also in history, economics, and related fields. He was making it known that The Ohio State University should become an archival center for documents, materials, and books treating the history of forestry and the forest industries in Ohio. These interests would later expand into other areas of conservation, wildlife management, agriculture, and biology. He further noted his own work of bringing together archival materials in botany from his home academic department.

Rudolph's early interest in The Ohio State University Libraries showed in a very perceptive letter written in January 1966, to Richard H. Armitage, Dean of the Graduate School. He elaborated on four items of special concern for the future of the University Libraries. These were (1) to increase funds to an inadequate budget to maintain its already "fine status," (2) to recommend the establishment of a graduate–level library school, (3) to acquire more space for current and future expansion of the library holdings and services, and (4) to develop and support the acquisition and curation of special research collections for use in graduate teaching and research. During the succeeding 25 years, many of the recommendations that were presented in Rudolph's letter have come to fruition. Although the budget always falls short of being adequate or of what is desired, the Friends of the Libraries, which was organized in the mid-1970's, has assisted by soliciting donations of books and acquiring funds to improve the library system. A library curriculum and degree program has been developed jointly with Kent State University in northeastern Ohio. More space has become available through the acquisition of a building to house an undergraduate library, and new space has become a reality for many of the individual specialty libraries in various disciplines at different places on campus. Facilities for manuscripts are now an integral part of the library system, including the University Archives and Photo Archives for University administration activities, and a Rare Books and Manuscripts Library for research papers of faculty members and other scholars. Of the four items about which Rudolph wrote to Dean Armitage, it would be no surprise that financial support of the libraries is still of the greatest concern today.

Rudolph's most active involvement with University Libraries since his arrival at the University came when President Novice G. Fawcett appointed him in September 1966 to a four–year term to the Library Council, the faculty governing group for University Library affairs. From then on Rudy learned of the problems, needs, weaknesses, and strengths of the University libraries. He served from 1966 to 1970, and then returned to the Council from 1980 to 1983.

ESTABLISHMENT OF THE FRIENDS OF THE OSU LIBRARIES

By the early 1970's, a group of 35 interested individuals on the campus, including Emanuel D. Rudolph, began meeting to find ways to bring additional

financial support to the University Libraries. In December 1974, members of this planning board established the Friends of the Libraries of The Ohio State University, with Eleanor M. Kilgour as the Executive Secretary. At the first annual meeting, held 5 June 1975, with sixty invited prospective members in attendance, Rudolph was elected recording secretary of the Board of Directors. He was also appointed to the Acquisitions Committee during this first year. By 1978, membership in the Friends had reached over 400 individuals and the organization was becoming well–established (Kilgour 1979). Rudolph continued as a member of the Board of Directors and served as vice–president from 1976 to 1977, and president from 1978 to 1980. While he was president, the Friends launched a two–year membership drive, begun with the guest appearance of OSU alumnus–playwright, Jerome Lawrence, the designated honorary national chairperson (Fig. 9). Mr. Lawrence spoke to the present and former members of the Board of Directors at a special luncheon held in the OSU Faculty Club, 25 October 1979 (Anonymous 1979). Hugh C. Atkinson, Director of the Libraries, expressed his personal and heartfelt thanks in a letter to Rudolph in 1976 for his service on the Board during its important first year, and noted that Rudolph had given the organization both definition and direction. At the beginning of Rudolph's second year as president of the Friends in 1979, William J. Studer, Director of the Libraries, wrote Rudy a very praiseworthy and encouraging statement:

FIGURE 9. The occasion of launching a two–year membership drive by the Friends of the OSU Library, Faculty Club, 25 October 1979. Left to Right: Emanuel D. Rudolph, president of the Friends; Lewis Branscomb, former director of OSU Libraries; Jerome Lawrence, honorary national chairman of Friends; Eleanor Kilgour, executive secretary and founder of Friends in 1974; and Linda Bowers, executive secretary successor to Mrs. Kilgour as of 1 October 1979. (Studer 1979; Photograph courtesy of Friends of the OSU Libraries).

> "From your participation in the original Friends planning group to the present moment you have been among the best and most reliable of the supporters of the Libraries. I feel confident of Friends going forward smoothly under your presidency in the transitional year ahead and am grateful for your willingness to continue to serve, particularly in light of your added responsibilities as chairman of the Biology [i.e. Botany] Department."

Rudolph was asked to return to the Board in 1991 to serve a second term for one year as President (1992–1993), while the Board was revising the length of terms during which its officers serve, as noted in a letter of 10 June 1992 from Elizabeth Wheatley, Director of the Friends of the Library. His first meeting with the Board as President was scheduled for 23 July, but his death came one month before this meeting.

Rudolph was an active member and promoter of the Friends of the Libraries, as revealed in personal letters and feature articles describing his accomplishments printed in various campus publications (Anonymous 1991, Holzman 1990, Ware 1990). In a 1978 letter to his University colleagues, Rudy pointed out some of the needs of the University Libraries and reasons why they should join the Friends of the Libraries. Rudy was convinced that an agency was needed to publicize the Libraries' collections and services and encourage gifts of books and money for their enrichment.

ACHIEVEMENTS IN THE FRIENDS ORGANIZATION

Rudolph recalled, in an interview during 1990, that one of his proudest achievements for the Friends was a series of programs he organized to help individuals who were just beginning to collect books. Area bookdealers gave talks on various aspects of book collecting, and the program attracted many new members for Friends. Rudolph believed that it also encouraged some of these collectors to donate books to the book sales and in some cases even to bequeath their entire collections to the library (Holzman 1990). One of these collectors' seminars was held on a winter February evening at the Rudolph's home where Friends could view their private library, then numbering 26,000 volumes and still growing (Anonymous 1980). That evening Rudy provided some pointers for wise book collecting, including collecting with direction or purpose, continuity in effort, and consistent quality. He spoke informally on the monumental task of maintaining a large private book collection, emphasizing the necessity of having accurate, detailed accession books, and of keeping the collection in good condition.

When discussing book collecting, either during seminars or during interviews with feature writers, as he did with Jane Ware (1990), Rudolph stressed that a book "collection has to have a focus and a theme. An accumulation is not a collection." The theme of the Rudolphs' collection represented different subjects of particular interest to them. Among them were the natural sciences, botany, children's natural history, book collecting, biographies, polar studies, agriculture, horticulture, and works by specific authors. Each collection was grouped together in its own area in their house. The books on each subject had their place, for example, monographic works on plants and tree books in the

third floor room, polar books in a second floor guest room, general botany books in the upstairs hallway and master bedroom, button and costume books in Ann's room on the second floor, cookbooks in the kitchen, and economic botany and agriculture books on the enclosed front porch (A. Rudolph 1990). Rudolph also emphasized in these seminars that it is possible to obtain inexpensive books by searching for those which no one else wants, thereby creating a unique and different kind of library. Because the Rudolph library contained a large component of children's natural history books, as well as textbooks on general science, biology, and botany, their library was, indeed, different and unique in that respect. Other book categories provided further uniqueness and diversity. He found these kinds of books, which are often discarded, at Salvation Army, Goodwill, and Thrift Shop stores that sell used books (Ware 1990).

The opening of the Rudolph home was a treat to visitors, and on the particular occasion of 27 February 1980, three known letters of thanks provide further descriptions of the evening. Linda Bowers (7 March 1980), executive secretary of the Friends, wrote that the evening was very delightful, and took genuine pleasure in hearing about a fascinating, extraordinary private book collection. Bill Radloff (3 March 1980) of Westerville wrote that he appreciated being able to see how a fellow collector was able to house, catalogue, and maintain such a splendid collection. William J. Studer (4 March 1980), Director of Libraries, expressed his personal thanks by writing:

> "It was a rewarding and enlightening experience for all to see and browse a home collection as extensive as yours — made doubly pleasurable by the exquisite refreshments afterwards. Friends is certainly in your debt for this occasion, as well as for your long and faithful patronage."

Ann offered her own description of the evening in a letter to her parents (3 March 1980):

> "Last Wednesday we had 40 people in to see the library and talk about collections. A great group and lots of questions were asked. One person came just to see costume books, another Wm. Blake, etc. . . . some out of curiosity. Two came 1/2 hour early as they were so excited. There was a photographer shooting pictures for a while. One pair of gloves was left; owner has not claimed them yet. Food all disappeared, lots of wine and sherry left over. We prepared a 6–page handout about the collection and an outline of what Rudy told them (in about 1/2 hour)."

In the 1960's, before the Friends of the OSU Libraries was organized, the Rudolphs proposed and enthusiastically supported a Student Book Collection Award. The third annual contest, announced in the student newspaper, OSU Lantern (Anonymous 1966), listed Emanuel D. Rudolph as one of four judges. He was determined that The Ohio State University students should be introduced to the joy of book collecting, an avocation that meant so much to him. The contest, organized to promote and encourage book collecting, was available to both undergraduate and graduate students, with each group competing separately. In cooperation with personnel from the Rare Book Room, Rudy organized the event, while Ann persuaded local bookdealers to contribute prize money to the winners (Holzman 1990, Studer 1992a).

Since 1978, the biennially held contest has been sponsored by the Friends. Rudolph served as a judge for many of the contests. The results are announced in an event highlighted by an evening with a guest speaker and the award-winning students presenting a short paper about their book collection and receiving their awards. In the 1992 contest, more than $700 was awarded in prize money (Cody 1992).

Rudolph assisted in many of the archival acquisitions for the Rare Books and Manuscripts Collection in the Main Library of The Ohio State University. He was involved in placing archives of departmental botanists William A. Kellerman and John H. Schaffner into the collection, as well as the extensive personal diaries of Milton B. Trautman, well–known Ohio ichthyologist and ornithologist, and Andrew D. Rodgers III, author of seven authoritative books in the history of botany. In a wider arena, he was active in the acquisition of Joseph Banks' "Florilegium," a fascinating series of recently printed plates from the original engravings, illustrating the plants that the author/artist encountered as the naturalist on Cook's first voyage to the South Pacific (Rudolph 1983). He also contributed efforts to the acquisition of the papers of Admiral Richard E. Byrd, pioneer Arctic and Antarctic explorer.

As an active volunteer at the many Friends programs and events, it was not unusual for Rudolph to donate books to the semi–annual book sale, work as a volunteer on a shift during the sale, then buy more books from the thousands donated to the Friends. "Ann liked to say that Rudy would donate books to the sale and then buy them back during the sale" (Studer 1992b). Rudolph has been quoted, "We need to keep reminding donors that the books they give don't just go to the sale. The librarians sift through them, adding many books to the permanent collection. So the sale doesn't just raise money for the libraries—it raises books" (Anonymous 1991).

Like the many supporters who are Friends, Rudolph was aware of the enormous importance of the strong research library at Ohio State and the long–term need for extra dollars. "Donations of private book collections, annual cash contributions, or gifts made in honor or in memory of family or friends (recognized with special book plates in selected volumes) are some of the many forms that giving to the libraries can take. Gifts that keep on giving—named endowed funds, trusts, and bequests—can benefit generations of University teachers, scholars, and students, while insuring that the donors' contributions will be recognized" (Anonymous 1991). Rudolph was convinced that a gift to the libraries strengthened the University's most important shared resource. He assisted University Libraries in acquiring donations from other collectors as well as helping to locate funds for special purchases.

LIBRARY ACTIVITIES BEYOND OSU

As a library friend, Rudolph's activities extended beyond the University. He joined the Ohio Friends of the Libraries (OFL), and was elected President for 1987–1988 and President of its Board of Directors for 1988–1989. This organi-

zation was created in 1973 to aid Friends of Library groups throughout the state to create better libraries for the people of Ohio. Its publication, *Ohio Libraries*, contained a president's column, and Rudy's presidential messages in 1988 reveal some of his ideas and thinking on library friends groups (Rudolph 1988). As president, he hoped to improve the organization and better its activities. In his initial message, he related that Ohio Friends of the Libraries are needed to give advice and help in times of need, and urged that the group be a forum for public discussion of state–wide issues relating to libraries.

Among the primary goals of the Ohio Friends of the Libraries were to help (1) organize or rebuild Friends groups for libraries in Ohio, including private, public, and school libraries; (2) publicize Friends of Libraries groups at various meetings; (3) become aware and supportive of the needs of Ohio libraries; and (4) become informed of the issues concerning libraries. Friends groups can have a major impact on a library by extending their visibility into the community, through engagement of projects aiding in fund raising efforts, and by providing excellent projects for volunteers. Rudolph himself encouraged (1) sidewalk book sales; (2) organization of local and oral history programs; (3) outdoor evening concerts to raise money; (4) workshops to promote particular interests, such as book collecting and book preservation; and (5) programs to excite children about books and reading.

During Rudolph's presidency, panel discussions stressing advantages for Friends groups in Ohio libraries were conducted at the six regional chapter conferences of the Ohio Library Association. These discussions, attended by members of Friends groups and librarians, were considered one of the major activities of the Ohio Friends of the Libraries during 1988. During his association with the Ohio Friends of the Libraries, Rudolph served on its Executive Committee (1984), as Secretary–Treasurer (1985–1986), as President–Elect (1986–1987), as President (1987–1988), and Past President (1988–1989). On its Governing Board, he was Vice–President (1987–1988) and President (1988–1989). At the time of his death, Rudolph was Vice–President of the Board of Directors for the Ohio Library Foundation, having been a member of its Board since 1989.

SUMMARY

Emanuel D. Rudolph was involved with books throughout his life. A rapid reader and indefatigable collector, he had a most unusual passion for having books. Even though he could not read every book in his library, he seemed to know enough about each book to allow him to discuss any one of them authoritatively. His teaching approaches and research investigations made extensive use of his library. Soon after joining the faculty of The Ohio State University, Rudolph became involved in University Libraries as a part of its governing council, and later as a key player in organizing the Friends of the Libraries, participating in their used book sales, collector seminars, acquisitions of special items, and student book collecting contests, and serving on its Board of Direc-

tors as secretary and president. Emanuel Rudolph, along with his most helpful and dedicated wife Ann, was a book collector extraordinaire and most generous and faithful library friend.

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ANN (WATERMAN) RUDOLPH

ANN WATERMAN RUDOLPH (1934–1991): HER LIFE WITH PLANTS, BOOKS, AND BUTTONS

Ronald L. Stuckey

Ann (Waterman) Rudolph was well known to many people, and yet not all of them knew her for the same reasons (Fig. 1). With a multitude of interests she won friends from many who walked different paths of life. Professionally Ann was a botanical bibliographer and information specialist for 26 years at Battelle Memorial Institute, Columbus, Ohio (1964–1990), and a nationally known antique button collector. She was the wife of Emanuel D. Rudolph, Professor of Botany and Research Associate with the Institute of Polar Studies at The Ohio State University, Columbus. They were married 11 August 1962 in Villanova, Pennsylvania, and lived in their home at 384 Arcadia Avenue, Columbus, Ohio. After a four-month illness, Ann (Waterman) Rudolph died at age 56 of pancreatic cancer in Riverside Hospital, Columbus, 26 April 1991 (Rudolph 1991 a, b; Stuckey 1993).

Coming from a fruit farm in rural northern Michigan, Ann Waterman became involved with plants while working in the orchards, in the family garden, and in the school's 4–H program. It is from this formative background that she took a more specific interest in plants and majored in botany in college, and then completed a master's thesis on the mints of Michigan. As a studious individual in elementary and high school, she came to love and appreciate books. Later she took formal training in library science and was employed in two library positions before launching her career as a botanical bibliographer and information specialist. Ann's interest in buttons was awakened when a child, but it was not until she was in her mid-thirties that time was devoted to pursuing this fascinating hobby of collecting and studying buttons.

FIGURE 1. Ann (Waterman) Rudolph. (Left) From Battelle Memorial Institute, about 1974. (Right) Graduation photograph, Leland High School, Leland, Michigan, 1952.

EARLY LIFE

On Independence Day, 4 July 1934, at the town of Sutton's Bay in Leelanau County, Michigan, Ann Herrick Waterman was born to parents who operated a fruit farm noted for its dark red sweet cherries (Figs. 2, 3). Here much effort was expected, but needed cash was scarce. She worked in the orchards during the cherry picking season, including many summers after her marriage. Ann (Fig. 1) attended the local public elementary and high schools, graduating as valedictorian from Leland High School, Leland, Michigan (1952). Ann was active in the 4–H Club and the Future Homemakers of America, serving as president of both of the local school chapters. She won 72 Certificates of Achievement in 20 different categories at the state level for outstanding projects in 4–H from 1944–1952. Five of these categories are noteworthy, because she won in those areas the highest number of years. These are complete costume (10 years), clothing (9 years), baking (8 years), food preparation (7 years), and junior leadership (6 years). In her senior year, Ann served as a class officer and a member of the student council and newspaper staff, and participated in the glee club, girls' basketball, class play, and ski club (Fig. 3). Ann became skilled in both skiing and archery. In 1948 she placed second in the Girls' Junior Division of the State 4–H Archery Tournament, and in 1949, at age 15, Ann won the 4–H Archery Championship for the State of Michigan (Fig. 4). As valedictorian, she spoke on "We Must Take Advantage," which stressed opportunities available for an educated person to acquire a knowledge of the country's culture, to become proficient in a vocation, and to put into practice the ideas and principles learned in a particular discipline.

LIFE WITH PLANTS

Because Ann had distinguished herself in leadership, citizenship, and scholastic achievement, she was awarded an entrance scholarship to Michigan State College, which was renamed Michigan State University before her graduation. Following the lead of her father and older sister, who had attended MSC, Ann entered as a freshman in the fall of 1952. While there, she became most interested in plants and earned the B.S. (1956) and M.A. (1959) degrees in Botany. Her thesis, "Taxonomy and Pollen Grain Morphology of the Labiatae of Michigan" (Waterman 1959), was completed under the direction of the plant taxonomist, Dr. John H. Beaman, in the Department of Botany and Plant Pathology. Ann was his first graduate student. The thesis research was based on examination of herbarium specimens and field work Ann conducted throughout the state accompanied by her pet collie dog, Min (Fig. 3). Two publications resulted from her graduate research: "The mints (Family Labiatae) of Michigan" (Waterman 1960a), and "Pollen Grain Studies of the Labiatae of Michigan" (Waterman 1960b). Special botanical studies were also taken with John Cantlon, ecologist, William Drew, taxonomist–ecologist, and Henry A. Imshaug, lichenologist (Fig. 5). At MSU, Ann was a member of the University Ski Club (Fig. 5), the *Semi-*

FIGURE 2. The Herrick Waterman Fruit Farm, Suttons Bay, Leelanau County, Michigan. (Above) Ann's parents, Margaret and Frederick Waterman, on tractors cutting and removing grass. (Below) The farm and farm buildings from a distance.

FIGURE 3. Ann Herrick Waterman in early life. (Above Left) Ann at age 4 in 1938. (Above Right) Ann with her pet collie dog, Min, taken on Ann's 18th birthday, 4 July 1952. (Below Left) Ann with her skis in winter. (Below Right) Ann in front of the stone built house, the Herrick Waterman home, December 1947.

FIGURE 4. Ann Waterman, age 15, First Place Winner in Girls' Division of the 4–H Club Archery Championship, State of Michigan, Summer 1949. Marshall Glade Stevens, Muskegon, Michigan, Boys Champion.

FIGURE 5. Ann Waterman at Michigan State University. (Above) In the field with Professor Henry Imshaug, lichenologist, Michigan State University, Northfort Point, Michigan, 2 June 1957. Photo by Clifford Whetmore; (Below) Michigan State University Skiers. L. to R. Don Haig, Ken Juyeron, Pat Hill, Sam Galle, Ann Waterman, Jim Hadley, Karen Visletta, Gene Hill, and Jerry Iveunon. ICSA Racer at Boyne Mountain, Michigan, 1956. Photo Print by Fred Moen.

narium Botanicum, and was elected to Sigma Delta Epsilon (1959), the graduate women's scientific fraternity. She also worked as a dormitory telephone operator for six months (1953). Philip Cantino, botanist at Ohio University, whose father was a professor at Michigan State University when Ann was a student there, wrote in a letter (29 December 1992) that Ann may have had an early influence on his life. She was an occasional sitter at their home, but Phil was too young to remember those evenings.

Ann augmented her education by attending the University of St. Andrews, Scotland (1954–1955). While there, she traveled to England, France, Spain, and Austria. The following summer (1956), she attended the Flathead Lake Field Biological Station of the University of Montana, where she studied algae under another Michigan State faculty member, Gerald W. Prescott (1956). For three summers, Ann was a museum aide in the Herbarium of the United States Natural History Museum, Smithsonian Institution (1957-1959) under Curators Lyman Smith and Mason Hale, and as a special student at Harvard University (spring 1958) studying pollen grains in the laboratory of Elso Barghoorn.

Following graduation from MSU, Ann Waterman was employed as an assistant botanical librarian at the Gray Herbarium in the Harvard University Herbaria under the direction of Librarian Lazella Schwarten (1959–1961). During the summer of 1960, she enrolled in a library science course at Simmons College, Boston. The following year Ann accepted the chief librarian's position at the Pennsylvania Horticultural Society, Philadelphia (1961–1962). Her botanical interests continued, and while there, she prepared a typewritten, mimeographed list of "Synonyms for Plant Names in 'Wild Flower' by Homer D. House" (1961), which apparently was useful for her patrons. Ann also continued her interests in skiing and served as treasurer of the Central Ski Club in Philadelphia.

In 1961, through mutual friends who were also botanists, Rolla and Alice Tryon and Michael Canuso, all of the Harvard University Herbaria, Ann Waterman and Emanuel Rudolph were introduced at the Tryon home in Lexington, Massachusetts, during an evening dinner (letter from Canuso, 6 January 1993). From that time on, the new couple were seen together attending social events, at picnics, and on walks in the fields and woods. It was about this time that Ann, who did not like the name Emanuel, called him "Rudy," a name by which she wanted him to become known. Not long thereafter, he was known affectionately as "Rudy" to most of his colleagues and friends, but not to members of his family who continued using Emanuel. On 11 August 1962, Ann and Rudy were married in an outdoor lawn wedding at the residence of Ann's relatives, Phoebe and the then late Otto Haas, the property now owned by John and Chara Haas, in Villanova, Pennsylvania (Fig. 6). Ann then joined her husband, who by that time had relocated to Columbus, Ohio, as an Assistant Professor of Botany in the Department of Botany and Plant Pathology and a Research Associate with the then Institute of Polar Studies (now Byrd Polar Research Center) at The Ohio State University (Fig. 7).

Emanuel D. Rudolph, who had been hired specifically to initiate and develop an Antarctic Research Biology Program with support guaranteed from the National Science Foundation, was studying in a broad biological context the cryptogamic plants, particularly the lichens, on the Antarctic continent. He had

FIGURE 6. Wedding of Ann Herrick Waterman and Emanuel David Rudolph, outside lawn at home of Ann's relatives, the Haas Family, Villanova, Pennsylvania, 11 August 1962. (Above) The Wedding Party, Left to Right: Bert Rudolph, best man, brother; Julia E. Merriwether, friend of the bride; Ann Waterman, Emanuel D. Rudolph, John Haas, Chara Haas, Jack Rudolph, father; Sarah Rudolph, mother; Phoebe Haas, cousin. (Below) Ceremonial scenes. Photographer unknown.

FIGURE 7. Ann (Waterman) Rudolph. (Left) As a graduate student at The Ohio State University, 1963. (Right) Working with ornamental plants at the Rudolph apartment, Columbus, Ohio, 1962.

already made one field expedition to the Antarctic in the austral summer of 1961–1962. A second field season began in early October 1962, and Rudy conducted studies at Hallett Station at the north end of the Ross Sea. Meanwhile, beginning in December 1962, Ann Rudolph, travelling alone, was on vacation in Hawaii, American Samoa, Tahiti, Fiji, and New Zealand (A. Rudolph 1962). There she joined Rudy's friends, Jessica and Robert Cooper (letter, 11 November 1992) in Auckland, and took bus tours to scenic places north of the town. Following completion of Rudy's field season, he and Ann met at Christchurch, New Zealand, in early February 1963, and then traveled for several weeks on the South Island for a belated honeymoon. In early March 1963, the Rudolphs returned to New Zealand to be with the Cooper family, enjoying travel and picnics. Upon settling in Columbus, Ann (Fig. 7) worked as a technician in the plant anatomical and paleobotanical laboratories of Richard A. Popham and James M. Schopf, and enrolled in graduate–level courses in botany at The Ohio State University (1963–1964).

LIFE WITH BOOKS

With her training in botanical science and librarianship, Ann Rudolph had the ideal credentials for employment as a bibliographer and information specialist. Ann joined the Battelle Memorial Institute, Columbus, in December 1964, when she was hired by Dr. Richard Davidson, Director of Biological Research. She was to acquire the documents and prepare a tropical ecology bibliography and an environmental thesaurus for the library of the Ecological Information Analysis Center (EIAC) at Battelle. This center was established to plan and manage the information relevant to nuclear excavation considerations of an Interoceanic Sea–Level Canal in Central and/or South America. With the research investigators on that project, Ann prepared computer-generated bibliographies, thesauri, indices, and six technical reports from 1964 until the project terminated in 1970. Following that phase of her work, Ann became involved in studies of fuels and wastes associated with nuclear power plants and their bioenvironmental effects. Seven additional technical reports on these topics were prepared between 1971 and 1984. Evaluations of Ann Rudolph's performance at Battelle consistently stated that she was conscientious, hard–working, and highly respected by her co–workers. She was credited as contributing significantly to the quality of the prepared reports. Throughout her career at Battelle, she developed and maintained the ecological/environmental library. A large portion of this library is now incorporated within the Herbarium Library at The Ohio State University.

Ann was affiliated with several professional botanical and library information societies. Among them (with year joined in parenthesis) were the Botanical Society of America (1959), International Association for Plant Taxonomists (1960), Philadelphia Botanical Club (1961), Massachusetts Horticultural Society (1964), American Society for Information Scientists (1964), The Ohio Academy of Science (1968), Council on Botanical and Horticultural Libraries

(1970), Columbus Natural History Society (1970), Ohio Historical Society (1970), Classification Society (1976), and the Society of Ohio Archivists (1982). As a member of The Ohio Academy of Science, she prepared lists of new books received, which were published in *The Ohio Journal of Science* (A. Rudolph 1974a, 1975, 1977). With the Friends of the Libraries of The Ohio State University, Ann participated in the book collecting seminars and helped raise funds for the biennial student book collector award. One of her published papers described a Friends-sponsored preservation workshop that discussed the problems, methods, and uses of materials for preserving books, manuscripts, and other archival items (A. Rudolph 1984). Ann was a founding member of the Friends of the Institute of Polar Studies, OSU (1980), its president, and an active promoter of the popularization of its activities. Toward that effort, along with Rudy, she prepared a selected bibliography of Antarctic books for children (Rudolph and Rudolph 1988), with the aim of inspiring the next generation to expand its reading horizons. Ann was appointed Archivist/Historian of the First Congregational Church, Columbus (1982). As a volunteer for the church, she spent a small portion of her free time organizing its archival and library resources. For nearly thirty years, Ann and Rudy developed a personal library of over 53,000 scientific and technical books which she cataloged on 3 × 5 cards and entered each title and associated information in an accession book (Fig. 8). The history and development of the Rudolph Library is described in another paper in this issue (Stuckey 1995).

The Rudolph home on Arcadia Avenue became virtually an over–flowing museum, for in addition to the "Books and Buttons," which was also the name of their business operation with these items, their entire house was filled with numerous artifacts and antiques. The color scheme was predominantly orange, brown, black, and white, and the walls, shelves, and floors were decorated with many items of southwestern United States Indian culture. Among these were vases, bowls, baskets, tapestries, rugs, and paintings. The latter included two expensive San Ildefonso pueblo gouache paintings by Awa Tsireh and Tonita Pena and one Acoma pueblo gouache painting by Richard Chino. Numerous Roycroft bookends with various designs of flowers and birds were used throughout the house. An idea of the number of hanging items that were left in the house after the Rudolphs' deaths can be comprehended after knowing that the new owners removed 211 hooks from just one room, the kitchen. Outside, adjacent to the house, little space was available for a garden; however, Ann did take some time to work on home landscaping. In a letter to her parents of 28 April 1975, Ann wrote about "Yard work in the afternoon as [it] was a very beautiful day: Fritillaria in flower, spring beauties are coming back after the [library] construction disruption, tulips, narcissus; twinleaf (*Jeffersonia diphylla*) and other things are in flower." In the next week's letter to her parents (4 May 1975), she noted that "If all of the spring flowering shrubs, trees and bulbs are not now in flower they are about to burst forth; what an exhilarating time! Even our yard looks better than ever."

The house was constructed with oak floors, woodwork, and doors, and the walls were of a dirty–white plaster cracked in many places and covered by bookcases, numerous paintings and other wall hangings. Oak-beamed ceilings

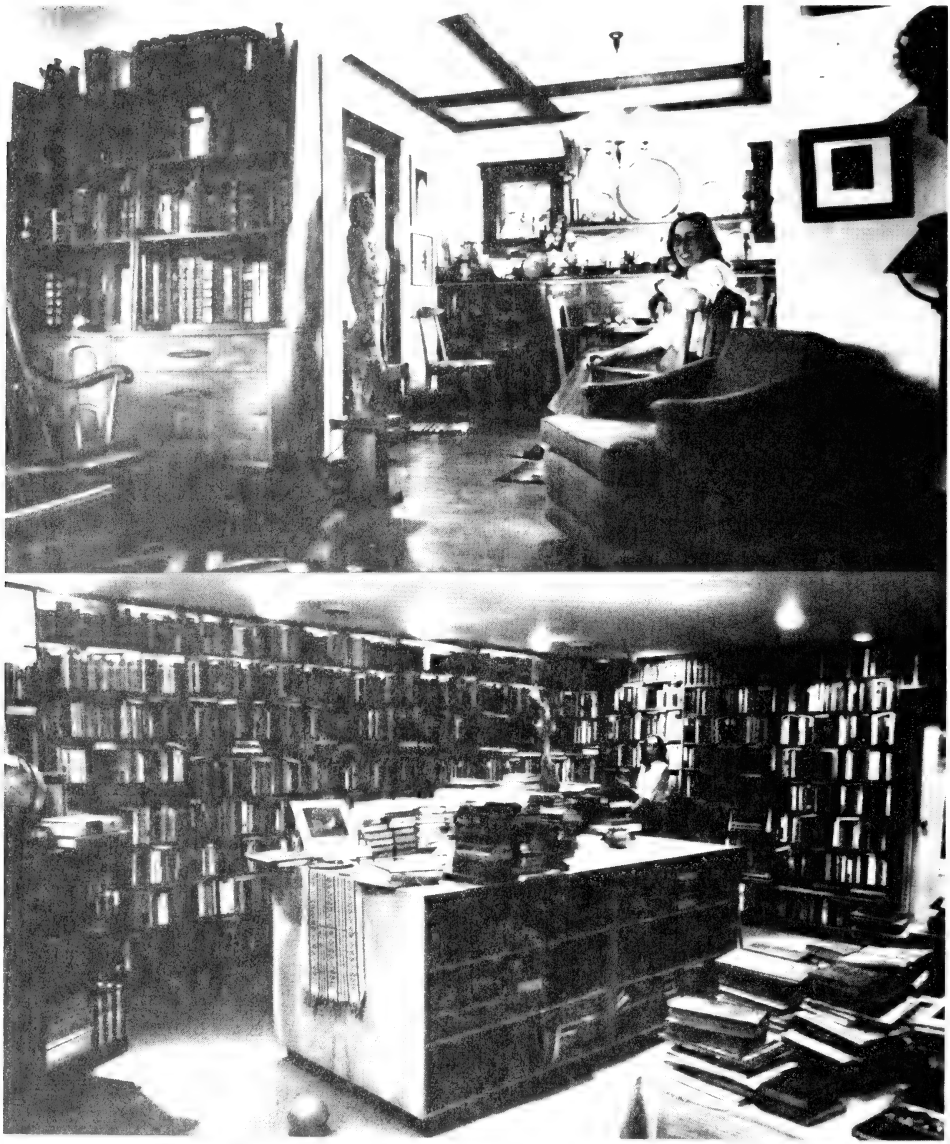

FIGURE 8. Two rooms of the Rudolph Home at 384 Arcadia Avenue, Columbus, Ohio, Spring 1977. (Above) View of living room looking into the dining room, with Ann in the open doorway. (Below) View of the library room addition to the house in 1972. This photo shows the children's natural history book collection.

FIGURE 9. The living room of the Rudolph Home at 384 Arcadia Avenue, Columbus, Ohio. (Above) Ann and Rudy sitting on the Stickley Prairie Settee, 1 January 1991 (4 months before Ann's death). Photo by Rita Berra. (Below) The fireplace flanked by glass door bookcases with many artifacts on the shelf above, August 1992. Photo by A. E. Spreitzer.

were in the dining and living rooms, and a decorative fireplace flanked with glass–door bookcases was built in the latter room (Fig. 9). The furniture in this room consisted of a mission oak "Stickley" high–backed settee and sofa, along with various chairs and end tables. In front of the sofa was a coffee table hand–made of native walnut by Ann's father. The table top always was covered with current magazines, such as *Smithsonian* and *The Magazine Antiques*. Books on history, literature, and poetry occupied the glass–door bookcases adjacent to the fireplace, and along another wall was a large open bookcase where Rudy shelved many of his oldest classical botanical books. In earlier days, a large wooden rocker, placed in front of this bookcase, was a favorite chair of Rudy's. Two other bookcases in the front hallway contained books on floral symbolism, flower poetry, and language of flowers. In the Rudolph home the books on each subject had their place, as is described in another paper in this issue (Stuckey 1995). Ann prepared a ten–page typewritten, single column list of the subject categories and room locations for the "Arrangement of Books" in the Rudolph Private Library in both of their houses (A. Rudolph 1990).

The opening of the Rudolph home was always a treat for their many friends and visitors, and they also hosted guest speakers at the University, book collecting groups from the friends of the OSU libraries, and students from classes in the history of biology and botany. At the time of Rudy's death, James D. Lawrey, one of his graduate students, wrote (22 June 1992): "Both he and Ann had an easy grace and good humor and I have always felt obligated to them for taking care of me early in my career at Ohio State. I shall remember with great fondness the evenings spent at their home among the books and the buttons." These events were always doubly pleasurable to the guests because of the exquisitely tasty refreshments that Ann served them, although on one particular occasion Ann wrote to her parents (28 April 1975) that she "served popcorn, dried cherries, raisins and drinks . . . very simple."

LIFE WITH BUTTONS

In the 1960's, Ann Rudolph seriously began her hobby of antique and studio button collecting. She described its beginning in a letter to a cousin Martha Collins of Fort Worth, Texas (21 August 1990):

> "I've been an antique button collector for over twenty years. Unfortunately none of the buttons in the collection are from family members. My mother gave away the 'button bag' when I was in college at Mich. State in the early '50s. But association means little to collectors who are mostly interested in age, usage, construction and rarity."

In 1991 Rudy also wrote about how Ann became interested in the button collecting hobby (Rudolph 1991b).

> "Ann's interest in buttons was implanted as a child by a family friend and later aunt–in–law, Aunt Bonnie from Dayton, who was a button collector. When another aunt died

in 1963, and Ann inherited an interesting button string, the implanted seed germinated.[1] She went to Dayton to consult with Aunt Bonnie and ended up buying her collection. At first, Ann's primary interest was in plant designs on buttons, but that soon expanded. Many members of the Buckeye State Button Society, and especially Mrs. Nellie Van Buskirk of Columbus, Mrs. Myrtle Harris of Zanesville, and Mrs. Elizabeth Kalill of Cleveland, helped her learn about button collecting and button lore."

Organized button collecting may have begun in Columbus, Ohio, when Mrs. Buskirk became the first president of the National Button Society, founded in 1939. This statement is credited to Ann Rudolph in 1980, when she was president of the *Columbus Fibulatics*, a local button club that she was instrumental in founding in 1971 (Wessa 1980).

Ann was so intent on collecting buttons that she obtained a bank loan of several thousand dollars to purchase two collections. Her buttons were kept in the basement button workshop room and her books on buttons and costume were in a second floor room at the immediate right of the stairway (Fig. 10). Special buttons, mounted on cardboard and framed, were displayed throughout the house, including her second floor book room and the tiny downstairs "bathroom." Regarding the bathroom, Ann said during an interview, "My favorite room in the house is the one with the mirror. You can see them twice" (Boen 1984). Among some of the unusual buttons in her possession were 18th century beeswax buttons, early fastenings of ancient times that closely resemble safety pins, and phosphorescent ones that were worn in London during World War II, as they glowed in the dark during blackouts. In a later interview (Doulin 1987), Ann stated that before 1970, she "could not have told anything about buttons. But there is so much history and artistry that makes button collecting attractive. You can tell a lot about past cultures just from studying different buttons." Selected kinds of buttons in the collection were brass buttons from clothes worn by royalty in 18th century England, decorative buttons carved from seeds of an Australian plant, vegetable ivory buttons from a cured nut of a South American palm tree, buttons from Civil War uniforms, and a button from George Washington's military uniform valued at more than $1,000 (Doulin 1987). Ann's collection had great depth because of her specialization in "buttons with botanical designs or made of botanical materials, such as wood, paper, or vegetable ivory . . . Mrs. Rudolph is not the only one who has a botanical button collection in the country, but hers, if not the best, is one of the best" (Ware 1990).

Ann had a strong interest in doing research on buttons, an activity which she very much enjoyed. She was especially interested in the use of vegetable ivory palm nuts for making buttons and other items. She worked at classifying buttons by age, materials, and subject, and studied their history, took photographs, and prepared displays by topics for contest shows. Ann was active in the *Columbus Fibulatics*, and served in various offices in that club and also in the Buckeye

[1] These two ladies were not really aunts, but were given those titles by family members. Aunt Bonnie was a sister of the other aunt, whose name was Grace Rice. Mrs. Rice was the mother of Ann's stepmother, Hannah Rice (Kennedy) Waterman.

FIGURE 10. Two of Ann's rooms in the Rudolph home at 384 Arcadia Avenue. (Above) Second floor room of costume and button books. (Below) Basement button workshop room. Both photos August 1992 by A. E. Spreitzer.

FIGURE 11. Ann Rudolph entertaining with buttons. (Above) Ann holding one of her displays of buttons. Not dated. (Below) Ann entertaining with stories about buttons at the State Button Show, Marriott Inn on Hamilton Road, Columbus, Ohio, Saturday 20 April 1991. She died the following Friday evening, 26 April 1991. Her husband, Rudy, is with her in the bottom right photograph. Photographs provided by Lois Pool, Akron, Ohio.

State Button Society. She became nationally known by preparing award winning displays, providing leadership, and developing archival collections of the records in the local, state, and national societies. Ann often provided the entertainment at button meetings, telling stories of the history, lore, and uses of buttons (Fig. 11).

As a special button project, Ann Rudolph, as a member of the Ohio Designer Craftsmen, a non–profit organization serving artists/craftsmen in Ohio since 1963, suggested an exhibition of artists' studio buttons as a special display at the 1993 National Button Society Convention in Toledo, Ohio. The display would be presented to recognize the 1993 Celebration for the Year of American Craft. Ann was a catalyst in the early planning for this event, and although cancer ended her life before the exhibit was initiated, The Ohio Designer Craftsmen continued the project in her memory. Her dream was realized in early August 1993 when the organization met at the Marriott Portside, Toledo, Ohio. In a special room, a unique exhibit of artists' buttons was on display. "Artist's Buttons: Fascinating Fasteners," the presentation proposed by Ann Rudolph, stood as a tribute to her passion and interest in sharing her special enthusiasm with her fellow button collectors. Hundreds of button collectors converged on the room to indulge in their passion, "buttons." The vendors' room permitted the conference participants to immerse themselves in buttons that ranged from rare antiques to the common pearl and plastics that were popular a few years ago. Over 50 vendors from across the country provided the catalyst for these collectors.

The Executive Director of the Ohio Designer Craftsmen, JoAnn H. Stevens (1993), described the special event as

> "a loving tribute that excited not only the participating artists but amazed and thrilled the convention participants . . . Millicent Safro and Diana Epstein, owners of Tender Buttons of NYC and Chicago, selected the awards. The Buckeye Chapter of the Button Society sponsored the Best of Show Award in memory of Ann and Emanuel 'Rudy' Rudolph, beloved members of the society. It was both a tender and exhilarating experience to present this exhibit in honor of my friend Ann Rudolph."

Following Ann's death, Rudy was asked by some of her button collecting friends to comment on his wife's sense of style and interesting dress. He wrote, "They were not disappointed because they met an intelligent, friendly, and concerned person . . . a remarkable wife and button enthusiast. She always actively supported the hobby and stimulated others. Her presence and knowledge will be sorely missed." Ann had a flair for unusually fashioned dresses, sparkling clanging necklaces, fancy arm bracelets, and variously designed rings on her fingers. Her presence was always noticed, for she was a nervous person, and these items jingled and jangled as she moved about and used her hands and arms making appropriate gestures that coincided with her conversation. Ed Voss of the University of Michigan Herbarium recalls Ann's "colorful pink parasol" that she carried while a student at MSU (letter 25 April 1994). Concerning her own wearing apparel, Ann gave the following commentary in a letter to her father and stepmother, Hannah (20 June 1976):

"Sat. morn. did get on sale a golden cotton brushed denim slacks suit. Hannah, I have a dilemma. The two velveteen jackets I bought last fall at Gretchen's shop[2] just are falling apart. The skirts are fine (and were on sale). However, the jackets were not on sale. Should I write her about this? The pile is falling out in places I think do not get exceptional rubbing. The brown one tore near a seam. And I don't think I'm unreasonably hard on clothes. What do you advise?"

Ann would remove the store buttons from her clothes and replace them with collectibles. When she was interviewed by Jane Ware (1990), Ann was wearing a gray dress with British sterling silver buttons with designs depicting plants—gentian and edelweiss.

HOME AND FAMILY

Ann Herrick Waterman was the daughter of Frederick Herrick and Margaret (Hornkohl) Waterman, who married in 1928. She was the second child to an older sister, Nora, who married Lt. Col. Conway J. Smith. In 1961, their mother died at age 52. She was a pianist, soloist, and choir member of the Suttons Bay Congregational Church; a leader for 15 years of the Leland 4-H Club; active in the Leelanau County Red Cross; past president of the Leelanau County Extension Council; and a supporter of the local Cancer Society. Two years later her father married Mrs. Hannah (Rice) Kennedy.

Mr. Waterman, age 79 at the time of his death in 1982, lived in Leland, Michigan, and was a farmer and orchardist who moved to the area from Ann Arbor, Michigan in 1931. A 1927 graduate of Michigan State College, he was named Michigan "Farmer of the Year" in 1962. Mr. Waterman was the first orchardist in Leelanau County to operate solely with tractor power. He was also very active in a number of organizations, including the Northwest Michigan Farm Bureau for more than forty years, of which he served seven as chairperson, and the Leelanau Horticultural Society and the County Soil Conservation District, in both of which he held memberships for 24 years. He also assisted in organizing the Leelanau County 4–H program, was president of the county American Cancer Society for seven years, and a member and former officer in the Suttons Bay Congregational Church.

At the time of Ann's death, she was survived by her husband, Emanuel D. Rudolph; her stepmother, who died two weeks later; her sister Nora (Waterman) Smith and her husband Lt. Col. Conway J. Smith of Lake Leelanau; their children, Brook and Blake Smith of Traverse City; and Pamela (Smith) Bell with her husband Eric and their children, of Sutton's Bay. Surviving also are a stepsister, Mrs. Gretchen (Kennedy) Sprout, of Sarasota, Florida; and a stepbrother, James Kennedy of Evergreen, Colorado (Rudolph 1991a, Stuckey 1993b).

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[2] Gretchen's shop referred to a store operated by Mrs. Gretchen Kennedy) Sprout, Ann's half–sister of Sarasota, Florida.

ANN RUDOLPH'S LEGACY

Ann Rudolph was an intelligent, generous, and loyal friend to many. While progressing through life, she came to know the plants of Michigan, the books on information sources, and the history and lore of buttons. At her Memorial Service of 5 May 1991, the Rev. Dale Rosenberger of the First Congregational Church, Columbus, captured the many phases of her life (Stuckey 1993a). In the church she was a musician, collector, archivist, and historian. Whether it was baskets, books, or buttons,

> "She was no mere gatherer, . . . but was drawn rather by unseen ties and the need to know our forbears. . . . Ann did not live in the past. She brought the past to life." . . . "Ann was the cinnamon in the cake" . . . who "gave of herself freely. She brought with her an attitude of service as a librarian and bibliographer. Knowing that books . . . serve to inform. . . . She did her best always, it seems, to get books, and articles, and journals into others' hands. She was always giving me things. And I always read them too. She did her level best to serve in this way, . . ."

I, too, will remember Ann in this manner, for she also gave me items to read or told me about sources of information. Both Ann and Rudy gave financially to benefit college programs, to aid students, and to support conservation groups and humanitarian organizations throughout the country. Thirty–two charitable organizations received cash contributions during 1991.

After her death, Ann's body was donated to the Medical School of The Ohio State University. Ann's books on buttons and costumes were given to the Human Ecology Library at The Ohio State University. Her extensive antique button collection was donated to the Historic Costume and Textiles Collection, Department of Textiles and Clothing, College of Human Ecology at The Ohio State University, in addition to a substantial endowment in Ann's memory to support graduate research in the Department. Ann (Waterman) Rudolph will long be remembered through her various gifts to her friends and to the University.

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THE RUDOLPH BOTANICAL BOOK COLLECTION IN THE HERBARIUM LIBRARY AT THE OHIO STATE UNIVERSITY

Ronald L. Stuckey

Emanuel D. Rudolph's scholarly pursuits involved the entire campus of The Ohio State University, as he worked in the programs of polar research, botany (his home department), environmental biology, and, of course, with the libraries. He was very well known and very much loved by the librarians. With his wife, Ann, who was a recognized antique button collector, he became acquainted with individuals in the Department of Textiles and Clothing and the friends of the Historic Costume and Textile Collection.

The need for and importance of botanical libraries and herbaria were well understood by Emanuel D. Rudolph, who had the foresight to write in his will that his botanical books were to be placed in the University's Herbarium Library. This library, in its infancy only a few years ago, has grown rapidly under Dr. Tod F. Stuessy's leadership. Rudolph had foreseen the importance of the library in the new Herbarium facility that became available during January 1992 in a renovated campus building, the Museum of Biological Diversity. To this facility Rudy had already donated his herbarium of Antarctic and other lichens, botanical reprint collection, and many of his books on vascular-plant floristic and monographic botany. Rudolph understood the importance of having the books in proximity to the preserved specimens, so that both elements can be used together simultaneously.

DESCRIPTION OF THE RUDOLPH MEMORIAL LIBRARY READING ROOM

Because Rudolph had a rather large room for his office in the Herbarium facility, it became apparent to both Director Tod Stuessy and me, as executor of the Rudolph estate, that this room would be ideal for conversion into a library room similar to the one he and Ann developed in the 1972 addition to their home. It allowed for the creation, or re-creation, of a portion of their library at the University, and provided a new focus and positive adventure that eased the pain while dismantling the Rudolphs' carefully organized home library with its associated memorabilia of pictures, paintings, and buttons. This new library room brings a new focus and new direction for the Herbarium, and allows not only for the preservation of some of the Rudolph legacy, but also provides a new dimension in the literature resources for the plant systematics program and the Department of Plant Biology in the College of Biological Sciences (Fig. 1).

The Emanuel D. and Ann W. Rudolph Memorial Library Room resembles in

FIGURE 1. Herbarium Library in the Museum of Biological Diversity. (Above) Ronald L. Stuckey with librarians Sheila Campbell (left) and Sandra Wicker (right), and (right) Tod F. Stuessy, both photographs taken in the Rudolph Memorial Reading Room. (Below) left to right: John J. Furlow, Herbarium Supervisor; Tod F. Stuessy, Professor and Director; Thallia Blight, Secretary; Erica Armstrong, Graduate Student; Sheila Campbell, Librarian, and Sandra Wicker, Cataloguer. All photographs 10 January 1995, by Ronald L. Stuckey.

certain aspects the Rudolphs' main reading room as it was in their home at 384 Arcadia Avenue. In the right center portion of the new room are five double–sided, red–brown wooden bookcases that once occupied the stack area in their home library, and lining the walls from floor to ceiling are the bookcases that were from their second house, "the house just for books," on Indianola Avenue. Selected botanical prints, paintings, wall hangings, and other decorations from their home add to the decor of the room. Many of Rudolph's certificates, awards, and artifacts are displayed in a wooden case with glass doors. The desk and worktable were a part of Rudolph's Herbarium office and remain in the room. The rug on the floor is a purchase by the Herbarium. Opposite the entrance door hang two separate 10 × 14 inch black and white framed photographs, one of Rudy and one of Ann, and between them is a "gold plaque" with the inscription, "Emanuel David Rudolph 1927–1992, Ann Waterman Rudolph 1934–1991. Botanists, Scholars, Lovers of Books, Kind and Generous Friends."

The extensive library of over 53,000 books that Rudy and Ann acquired, according to his will of 23 May 1991, was to be donated to the libraries of The Ohio State University. Appraised at $850,000, the collection was divided appropriately during the summer of 1992 and distributed to the several campus libraries under the direction of Wesley Boomgaarden, preservation officer for the OSU Libraries. With the full–time assistance of John Frederick and other part–time library assistants, this task was completed by September 1992.

All of the botanical books, about 11,000 or one fifth of the total collection, were deposited in the Herbarium Library. This portion of the Rudolph library contains books on general biology, general botany, classification and taxonomy of plants, plant evolution, herbals, floras, horticulture, gardening, botanical gardens, fungi, lichens, mosses, liverworts, ferns, vascular plants, history of biology and botany, and biographies of botanists and individuals in related disciplines. Many of his older, more valuable botanical books, approximately 1,000 volumes, mostly published before 1840 and some dating to the 1500's, are in a nearby rare book room (Fig. 2). His books on mycology and vascular plant floras are in the main herbarium library room.

The University Herbarium and its associated Library, since occupying the building on Kinnear Road in January 1992, have grown immensely through gifts from several individuals and minimum purchases. The botanical books, periodicals, reprints, indexes, and reference works all housed together with the dried mounted plant specimens comprise a modern, usable teaching, research, and public service facility. This botanical reference facility, now numbering over 17,000 volumes of books, 450 titles of periodicals, and extensive collections of reprints of scientific articles, original and reference maps, and former faculty member archives, is a most valuable resource of The Ohio State University. The augmentation of its library holdings resulting from the unexpected deaths of the Rudolphs must now be viewed as a very positive development. As their memory lives on, it is anticipated that the numbers of library holdings and plant specimens in the Herbarium facility will continue to grow and develop into a data center of world–wide significance and use.

The immediate challenge for the Herbarium Library is to catalog its books

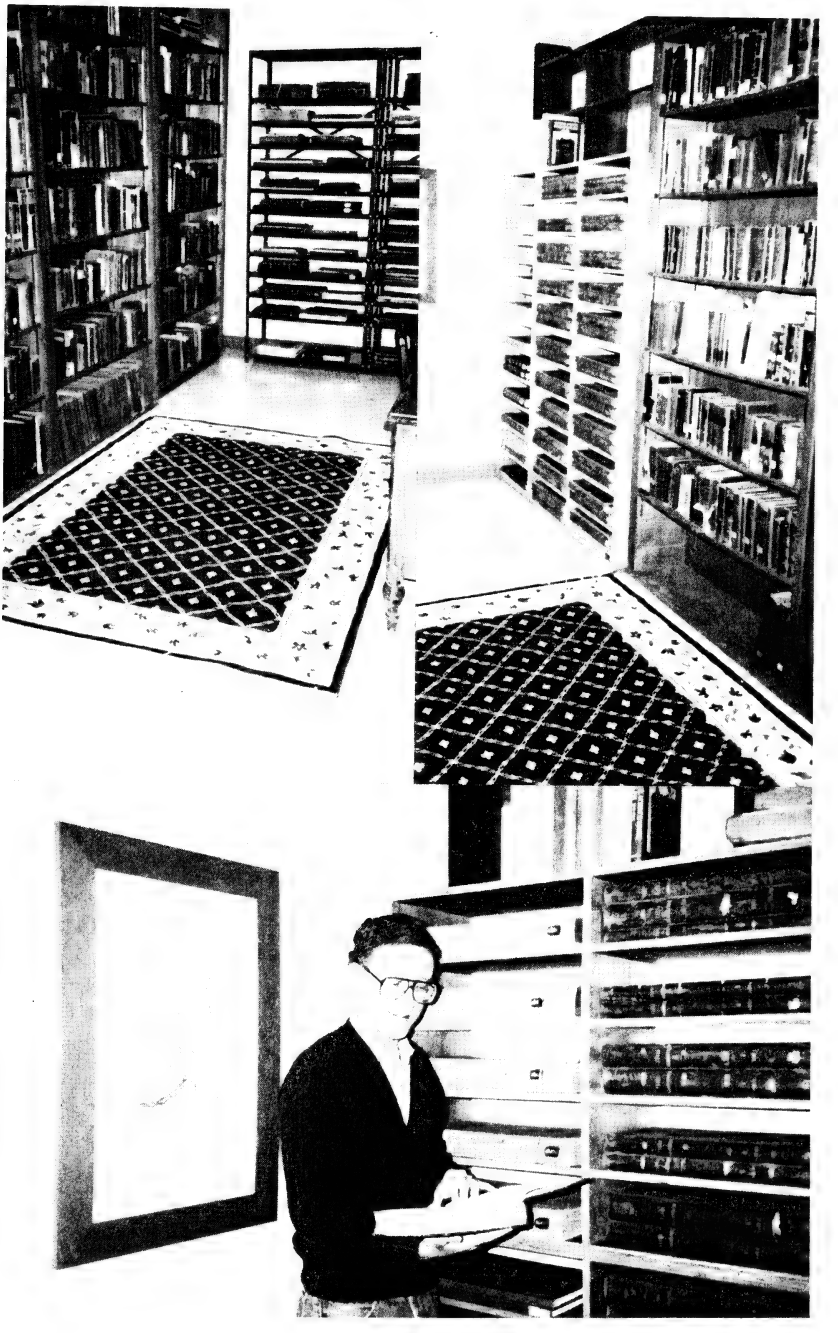

FIGURE 2. Herbarium Library in the Museum of Biological Diversity at The Ohio State University. (Above Left) Back view of the rare book room (Above Right) Front view of the rare book room. (Below) Tod F. Stuessy in the Rare Book Room. All photographs 9 November 1992, by Ronald L. Stuckey.

into the University computerized library system, making them accessible and available to the botanical community, university faculty and students, and the general public. In September 1994, this project began under the supervision of the cataloging department of The Ohio State University Libraries. A portion of the funding for this project has been provided as a challenge grant from John and Chara Haas of Villanova, Pennsylvania, relatives of Ann. Additional financial support has come from friends of the Rudolphs and the Herbarium.

DEDICATION OF THE RUDOLPH MEMORIAL LIBRARY ROOM

The Emanuel D. and Ann W. Rudolph Memorial Room provides a special place for patrons to read, write, and study, while remembering great times spent with this extraordinary couple. Formal dedication of this special room, held 21 May 1993, featured a symposium on "Botanical Libraries and Herbaria" presented by five speakers prominent in their research utilizing these kinds of facilities. Over 75 individuals attended the initial ceremony at 9:15 a.m., at which time a broad yellow ribbon stretching across the open doorway was cut by Tod F. Stuessy, Director of both the Herbarium and Museum. Stuessy welcomed the assembly and recognized with thanks the many volunteers who prepared the facility for this special occasion (Fig. 3). Dr. Ralph E. J. Borner, chairperson of the Department of Plant Biology, welcomed the group on behalf of the Department and the College of Biological Sciences. He reminded them that Emanuel D. Rudolph was an essential member of The Ohio State University faculty for many years, and that this Memorial Room and its collections represent a working legacy of his time here. It will be a reminder for those people who come to use it in the future. Ronald L. Stuckey, emeritus professor and curator in the Herbarium, stressed the need to have reference books in floristic, taxonomic, and geographic botany near the dried botanical specimens to allow for efficiency and accuracy while conducting research and for completing public service obligations in a timely manner.

The symposium itself was introduced by Tod F. Stuessy, followed by comments from Bruce Leach, Head of the Biological Sciences Library. Two of Rudolph's former Ph.D. students, Edmund A. Schofield (1972), Worcester, Massachusetts, and James Lawrey (1977), Fairfax, Virginia, introduced the symposium speakers. Both students related fond memories of their relationship with Rudy as their adviser and thanked the organizers for inviting them to return to the campus for this special memorable occasion. The speakers and their topics were Ronald L. Stuckey, "Emanuel D. Rudolph: Book Collector and Library Friend;" Wesley Boomgaarden, Preservation Officer, University Libraries, The Ohio State University, "Acquiring Great Private Collections for the Public Good: Ohio State's Experience;" Benjamin Williams, Associate Librarian, Field Museum of Natural History, Chicago, "Books in Herbaria: The Purpose of Proximity;" Judith Warnement, Librarian, Herbarium Libraries, Harvard University, "Botany Libraries of Harvard University: Preserving the Riches of the Past for Future Botanists;" and Laurence J. Dorr, Botanist, National Museum of

FIGURE 3. Dedication of the Rudolph Memorial Reading Room. (Above) Framed photographs of Rudy and Ann with gold plaque identifying them mounted on wall opposite doorway in the Memorial Room. (Middle) Standing in front of two double-sided bookcases in the Memorial Room,. Left to Right: Jay L. Ladd, Director of Department Libraries; Charles J. Kleibacker, Designer in Residence, Textiles and Clothing; Lucy R. Sibley, Chairperson Textiles and Clothing (deceased 26 October 1994); Holly Pugh, member Columbus Fibulatics. (Below) In the Herbarium adjacent to the Memorial Room,. Left to Right: Daniel J. Crawford, James R. Hoobler, unknown, Anne Kochman, Brian D. Gara, Richard Davidson, unknown, Jay L. Ladd, Lynn E. Elfner, behind him unknown, Lynn Lay, Ralph E.J. Boerner, behind him unknown, Tod F. Stuessy. All three photographs 21 May 1993, by Ronald L. Stuckey.

Natural History, Smithsonian Institution, "Archives and Libraries as Places to Resolve Botanical Puzzles: The Rebecca P. Dean-S. B. Buckley Mystery."

From funds of the Rudolph Estate and contributions from his family, friends and colleagues, the Emanuel D. Rudolph Botanical Fund of $87,875 was established 4 June 1993. The annual income from the fund is administered by the Director of the Herbarium in the Department of Plant Biology, and used for two purposes: "To support an annual Rudolph Memorial Lecture and associated expenses in the fields of cryptogamic botany, Arctic/Antarctic botany, or the history of botany. The remaining income shall be used for the preservation and continuation of the Rudolph Memorial Library in the Herbarium and related purposes." The first memorial lecture was presented by William Culberson, Botanist of Duke University, who lectured on "Sibling Speciation in Lichens," March 1994.

A check in excess of six hundred thousand dollars was presented on 7 May 1993 to The Ohio State University Development Fund by Ronald L. Stuckey, executor of the estate of Emanuel D. Rudolph. This transaction represented the final settlement of the Rudolph estate, which directed his major financial assets to the University. Emanuel D. Rudolph's will of 23 May 1991 specified that $250,000 was to be given to the Department of Textiles and Clothing in the College of Human Ecology for a specific endowment in memory of his wife Ann. In addition, to this Department and their associated Friends organization was bequeathed her extensive antique button collection. Four other units in the University received the remaining financial amount divided equally among them. They were the Friends of the Historic Costume and Textiles Collection, the Herbarium in the Department of Plant Biology, the Friends of the Libraries, and the Byrd Polar Research Center. The total financial contribution from the Rudolph estate supported each of Ann and Rudy's interests on campus about equally.

The check to the University was presented at a special luncheon at the OSU Faculty Club, with representatives from all of the departments and units receiving benefits. Stanton Darling and David Keister, attorneys representing the law firm of Darling and Keister, attended for the estate, and James R. Hoobler, Associate Director of Trusts and Estates, received the check for the Development Fund (Fig. 4). The group thanked Dr. Stuckey for his untiring efforts in settling the Rudolph Estate, and presented him with an important research reference book, the second edition of *B–P–H/Supplement, Botanico–Periodicum Huntianum Supplementum* (1991).

Most of the Rudolph bequest provided for the establishment of five endowments approved by the Board of Trustees in four major units of the University:

1. Textiles and Clothing: The Ann and Emanuel D. Rudolph Fund. $250,000.
2. Plant Biology: The Emanuel D. Rudolph Botanical Fund. $87,875.
3. University Libraries:
   a) The Emanuel D. Rudolph History of Children's Science Collection Fund. $15,000.

FIGURE 4. Presentation of Emanuel D. Rudolph's financial assests to The Ohio State University. (Above) Ronald L. Stuckey, executor of the Rudolph estate, writing check to the OSU Development Fund. Photograph Sandra Cody. (Below) Ronald L. Stuckey handing check to James R. Hoobler, Associate Director of Trusts and Estates, with David Keister, attorney for the estate. Photograph 7 May 1993, by David Dennis.

b) The Emanuel D. and Ann Rudolph Friends of the Libraries Student Book Collector's Contest Fund. $15,000.

4. Polar Studies: The Emanuel D. Rudolph Polar Studies Fund. $88,587.

CONCLUDING COMMENTARY

Toward providing any kind of conclusion or summary, it seems appropriate to quote selected passages pertaining to the Rudolph Library drawn from a larger context. Wesley L. Boomgaarden, preservation officer for The Ohio State University Libraries, stated in his presentation at the dedication of the Rudolph Memorial Library Room, 21 May 1993:

"It was not until the mid-1960's that The Ohio State University had both the interest and wherewithal to move into this area of special collections librarianship. Since then the University has built excellent and impressive special research collections in a number of areas to complement the strong general collections and programs. . . . All great research institutions acquire large and/or great collections, . . . [and] the true value of those collections depends upon a host of factors, perhaps the most important one being that scholars—active scholars and those yet unborn—await the opportunity to discover new insights and new knowledge for the benefit of humankind."

"The premise of the collection of collections by good libraries with astute developers is the knowledge that is gained. Significant collections of books and other materials of permanent research value that are thoughtfully collected, aware of how the individual pieces complement each other, are as a collection worth much more than the sum of their individual pieces. They provide tremendous value to future users of the collections. It is, of course, difficult to fathom the scope and degree of thoughtful collecting by such masters as Emanuel and Ann Rudolph."

"The resources brought together by such University-affiliated collectors as the Rudolphs in several subject areas . . . are often of inestimable value. These collections not only offer vast research informational and education potential, but also are in themselves monuments to human endeavor and achievement. . . . Stewardship is an appropriate term to use here. In libraries, we are 'stewards' called to exercise responsible care over these entrusted possessions. They are not our 'own,' but are held for the common good. Regarding Ann and Rudy's collections, we take on the role of stewards with a mixture of sadness in their premature passing, and pride that we have been called upon to continue the exquisite thought and care which they began. . . . A great deal of personal and professional satisfaction is derived from being involved in this work. We as professionals are especially touched to take over Ann and Rudy's work."

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On the cover: Photograph of Rudy and Ann Rudolph, at the Faculty Club, The Ohio State University campus, 8 June 1984.
Photograph by Ronald L. Stuckey

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STUDIES ON SILICA-SCALED CHRYSOPHYTES FROM NORTHERN INDIANA

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The freshwater algal flora of Indiana has been examined by a number of investigators (see Palmer 1929, 1931, 1933, 1936 and Daily 1972, for literature reviews). Although there have been a number of electron microscopic studies on North American scaled chrysophytes, to date none has been conducted on the Indiana algal flora. Electron microscopy has become a necessity to make accurate taxonomic determinations for most taxa of scaled chrysophytes. Species identification utilizes the morphology and structure of siliceous scales, spines, and bristles of a cell's outer covering (Wee 1982).

Recently, silica-scale bearing algae have become very important as bioindicators of changes in the quality of lake water, especially from a paleolimnological perspective (Siver 1995, Smol 1995 and the literature therein). In order to be able to utilize scaled Chrysophyceae and Synurophyceae in a similar manner in Indiana waterbodies it is mandatory that the flora be adequately described. This paper deals with silica-scaled chrysophytes occurring in several northern Indiana lakes and ponds.

METHODS

Phytoplankton was collected with a plankton net (10 μm mesh size) in June and July, 1993. Samples were preserved in acid Lugol's. Subsamples were air-dried on Formvar coated grids and examined with a Philips EM 300 electron microscope. Water temperature was measured at the time of sampling (Table 1). Other water quality data were taken at each site at the dates indicated in Table 1.

OBSERVATIONS AND DISCUSSION

Of a total of 13 taxa of scaled chrysophytes recorded, all but two are new to Indiana (Table 2). An asterisk before the name indicates a taxon first reported for Indiana.

Mallomonas acaroides var. *acaroides* (Fig. 1). This is the most widely distributed variety of six varieties that have been described. Within the United

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TABLE 1. Sampling sites, Noble and Whitley Counties, Indiana.

Sample No.	Name	Water Temp. °C	NH3 mg/L	Org-N mg/L	SRP mg/L	Tot-P mg/L	Alk $mgCO_3/L$	pH	cond. µmHOS	%light trans. @ 1m	NO_3 mg/L
1	Kesling Pond	30	–	–	–	–	–	6.4	–	–	–[a]
2	High Lake	30	0.018	1.41	0.0	0.032	159.5	8.6	405	8	0.022[b]
3	Rieth Gravel Pit	31	–	–	–	–	–	–	–	–	–
4	Crooked Lake	27	0.018	0.23	0.003	0.056	122.0	8.6	330	–	0.022[c]
5	Big Lake	27	0.027	2.11	0.008	0.029	140.4	8.4	450	37	2.031[d]
6	Tamarack Bog	22	–	–	–	–	–	3.5	45	–	–[e]
7	Leatherleaf Bog	29	–	–	–	–	–	3.9	40	–	–[f]
8	Leatherleaf Bog (lagg)	24	–	–	–	–	–	7.2	68	–	–[f]
9	Bear Lake	30	0.018	1.78	0.003	0.051	152.0	8.5	405	31	0.028[g]
10	Hickory Bog	22	–	–	–	–	–	5.3	117	–	–[f]

Except for water temperature, all other data taken as noted.
[a]Data taken 18 January 1996.
[b]Data taken 24 August 1993.
[c]Data taken 26 July 1994.
[d]Data taken 2 July 1990.
[e]Data taken 28 July 1993.
[f]Data taken 24 September 1993.
[g]Data taken 17 August 1993.

TABLE 2. Distribution of silica-scaled chrysophytes from northern Indiana, 1993.

Taxon	Locality*							
	1	2	3	4	6	7	8	10
Mallomonas acaroides Perty	+							
M. calceolus Bradley					+			
M. caudata Ivanov emend. Krieger			+	+				
M. mangofera Harris & Bradley	+							
M. multiunca Asmund	+							
M. paludosa Fott						+		
M. papillosa Harris & Bradley	+			+			+	
Synura echinulata Korshikov							+	+
S. mollispina (Petersen & Hansen) Peterfi & Momeu	+			+		+	+	
S. petersenii Korshikov	+	+		+		+	+	+
S. sphagnicola Korshikov						+		+
Paraphysomonas vestita (Stokes) De Saedeleer							+	+
Chrysosphaerella brevispina Korshikov							+	

*See Table 1 for locality

States, this variety has been reported from the Adirondacks, New England area, and the midwest.

**M. calceolus* (Fig. 2). The only previous records of this species for the U.S. are from the Upper Peninsula of Michigan (Wawrzyniak & Andersen 1985) and Connecticut (Siver 1989).

M. caudata (Fig. 3). A widely reported species in North America, it is distributed over a wide range of environmental conditions. It normally can be found during each month of the year (Siver 1991). It is also one of the few *Mallomonas* species that can be readily identified with the light microscope.

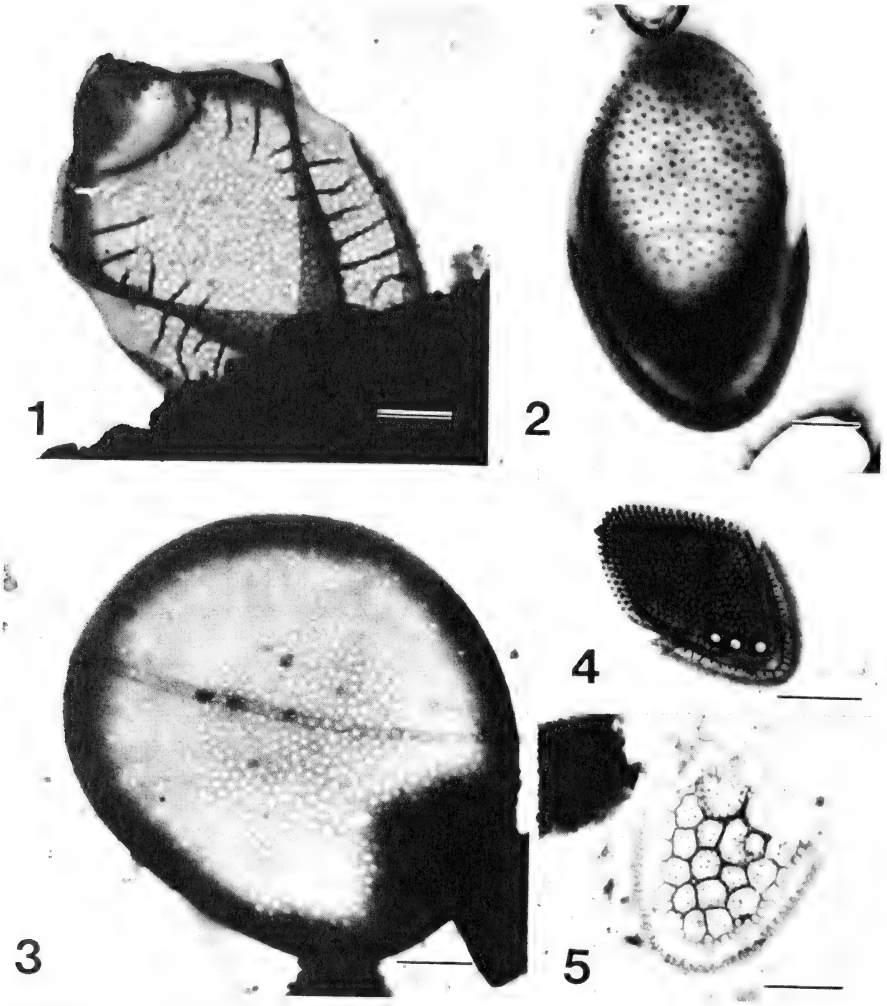
**M. mangofera* (Fig. 4). A spring species usually reported from cooler water (Siver 1991), it has been observed from a number of other North American localities.

*M. multiunca (Fig. 5). This was one of the first *Mallomonas* species to be observed with the electron microscope (Asmund 1959). Asmund and Kristiansen (1986) report its distribution on a world wide basis. Additional reports for the U.S. include Iowa (Wee & Gabel 1989), Connecticut (Siver 1991), and Florida (Wujek & Bland 1991).

**M. paludosa* (Fig. 6). Within the U.S., this species has been reported from northern Michigan (Wawrzyniak & Andersen 1985), New York (Siver 1988, 1989), Connecticut (Siver & Hamer 1990, 1992), and Florida (Wujek & Bland 1991). This taxon has been reported only from acidic environments; indeed, our report of it from Leatherleaf Bog corroborates this, as the bog had a pH of 3.9.

**M. papillosa* (Figs. 7, 8). It is widely distributed in the northern hemisphere. In Connecticut, its maximum occurrence was in November and December reflecting its preference for cooler waters (Siver 1991).

**Synura echinulata* (Fig. 9). This taxon has been reported from North America many times and has a worldwide distribution. The scales have a distinctive

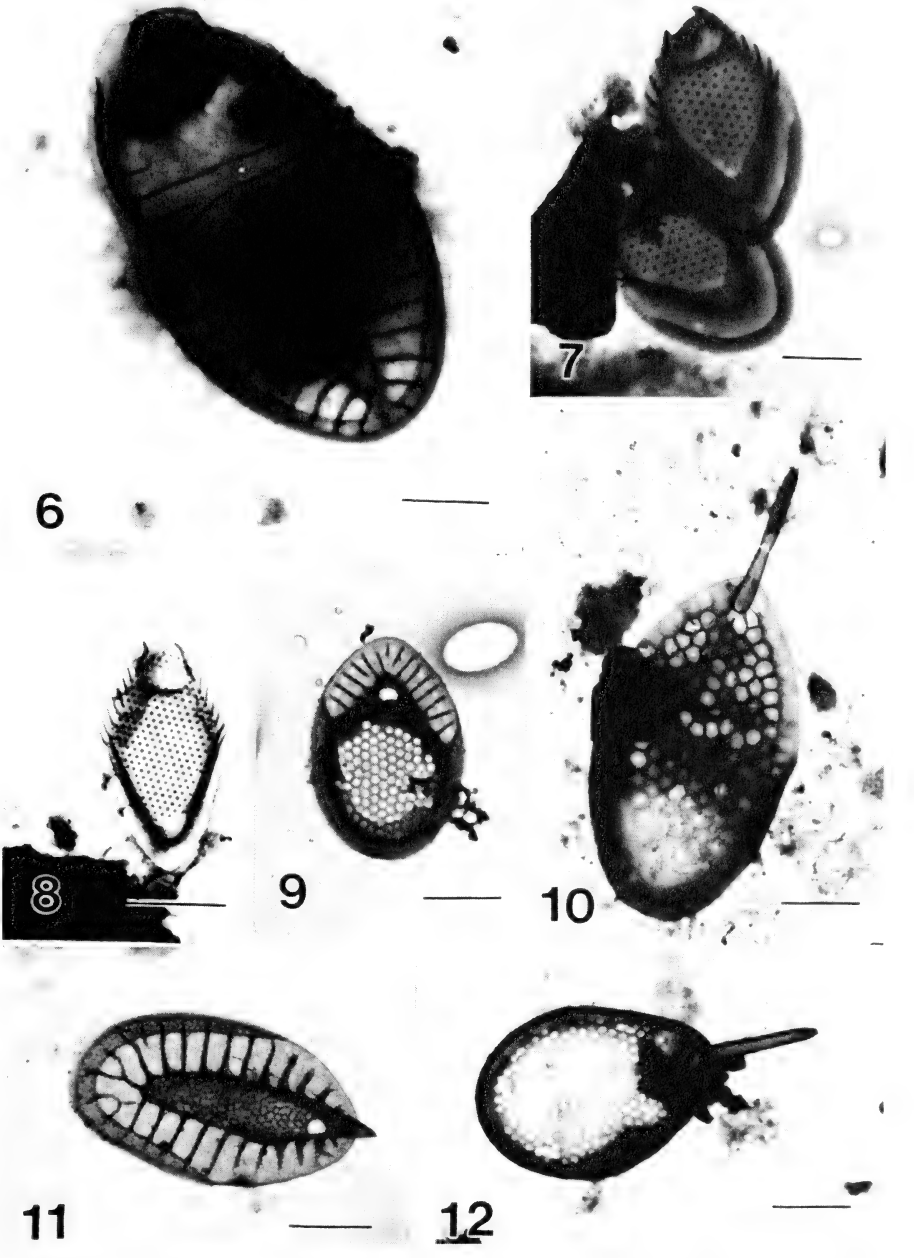


FIGURES 1–5. *Mallomonas.* Fig. 1. *M. acaroides.* Fig. 2. *M. calceolus.* Fig. 3. *M. caudata.* Fig. 4. *M. mangofera.* Fig. 5. *M. multiunca.* Scale bar = 1 μm.

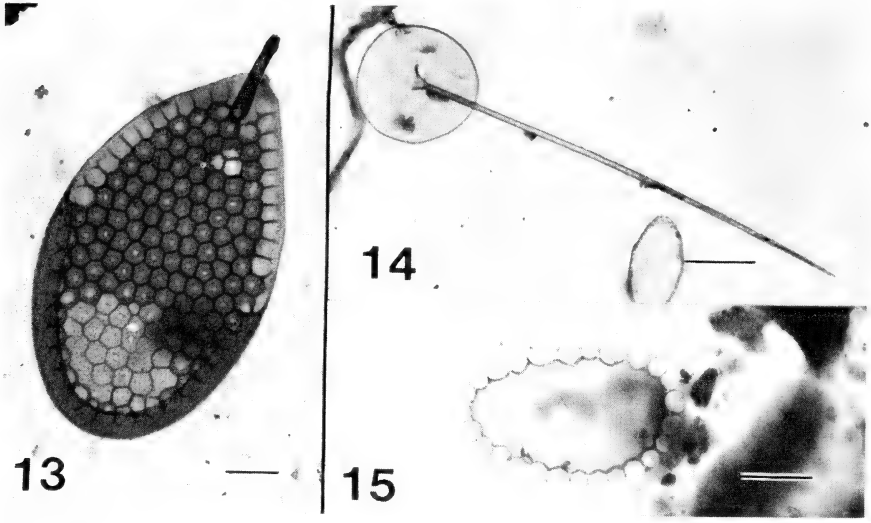
pattern on their distal part. The apical scales have prominent spines which may be perforated. Posterior scales either lack or have reduced spines.

**S. mollispina* (Figs. 10, 13). Wee (1982) suggests that the scales with their distinctive partial secondary layer on the reticulum are distinctive enough for this species to be identified with phase contrast microscopy. This is the fifth report of this species from the contiguous U.S. (Wujek et al. 1977, 1981, Wee 1981, Wee & Gabel 1989, Wujek & Bland 1991).

**S. petersenii* (Fig. 11). Kristiansen (1986) stated that it may be the most



FIGURES 6–12. *Mallomonas*. Fig. 6. *M. paludosa*. Fig. 7–8. *M. papillosa*. Figures 9–12. *Synura*. Fig. 9. *S. echinulata*. Fig. 10. *S. mollispina*. Fig. 11. *S. petersenii*. Fig. 12. *S. sphagnicola*. Scale bar = 1 μm.



FIGURES 13–15. Fig. 13. *Synura mollispina*. Fig. 14. *Paraphysomonas vestita*. Fig. 15. *Chrysosphaerella brevispina*. Scale bar = 1 μm.

widespread and common taxon of scaled chrysophyte in the world. It was also the most numerous of any of the species observed in our study.

**S. sphagnicola* (Fig. 12). Its reported global occurrence in acidic conditions (see Siver 1989 for literature) coincides with similar habitats in which it occurred in our study.

**Paraphysomonas vestita* (Fig 14). This is the most widely distributed *Paraphysomonas* species worldwide. Its absence in all but one sample was surprising owing to its numerous occurrences in species lists in other studies involving electron microscopy.

**Chrysosphaerella brevispina* (Fig. 15). A species having a world wide distribution and classified by Silver (1989) as being pH indifferent.

The chrysophycean flora of northern Indiana investigated to date does not differ essentially from what has been found in other similar northern hemisphere localities. The genera *Paraphysomonas* and *Chrysosphaerella* are newly reported for Indiana. Only two of the *Mallomonas* species previously reported for Indiana were observed in this study. What was most surprising was not observing the remaining taxa earlier reported for Indiana: *Mallomonas alpina* Pasch. and *M. pseudocoronata* Prescott as well as *Synura uvella* Ehrenb. All have been previously reported from northern Indiana localities (see Daily 1972 for literature) and appear consistently in species lists of other western hemisphere researchers. Their appearance, however, is generally in environments of higher alkalinity and pH than we report. Many of the earlier reports of *S. uvella* are probably *S. petersenii*; this is because LM, not EM, was used in making the identifications.

Our data suggest that the scaled chrysophyte flora is quite diverse and rich.

Surprisingly, no scaled chrysophytes were found in Big Lake and Bear Lake. However, because the samples represented only one time period, collections taken over a year would likely include more species in these lakes, especially during times of cooler water temperatures.

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THE VEGETATION TENSION ZONE ACROSS MICHIGAN'S THUMB AREA

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Regional analysis of plant and animal distributions is the traditional center of biogeography (Fosberg 1976, Taylor 1984, Myers & Giller 1988). Studies of pre-European settlement vegetation in North America are a notable component of this tradition, and a promising region for such work is southern Michigan's Thumb area. Although previous investigators have described presettlement vegetation in the Thumb (Marschner & Perejda 1946, Veatch 1959), my preliminary examinations of original land survey records (Dodge 1989) suggest conifers were more common and widespread in this region than indicated in earlier studies.

Thus the purpose of this investigation is to use original land survey notes to reconstruct presettlement distribution of conifers within the Thumb, map the tension zone (or ecotone) between deciduous and mixed coniferous-deciduous forests in this region, and relate abundance of conifers and forest geography to soil texture and natural drainage.

VEGETATION RECONSTRUCTION BASED ON ORIGINAL SURVEYS

General Land Office (GLO) survey notes are useful for generalized descriptions and mapping of regional vegetation (Shanks 1953). These records have served as important sources of information about pre-European settlement conditions in Michigan (Kenoyer 1940, Janke et al. 1978, Donnelly & Murphy 1987, Palik & Pregitzer 1992) and elsewhere in the United States (Wuenscher & Valiunas 1967, Rankin & Davis 1971, Dorney 1981, Fralish et al. 1991, Schwartz 1994).

Despite widespread use of GLO records, error is an inherent part of these surveys. Of greatest concern is surveyor bias in selecting corner and line trees, a process that was sometimes influenced by diameters and species of particular trees (Bourdo 1956). However, evaluations of this bias in surveys throughout the United States and Michigan have found little, if any, statistically significant systematic error in witness tree selection (Bourdo 1956; Hushen et al. 1966; Delcourt & Delcourt 1974, 1977; Lorimer 1977; Schafale & Harcombe 1983). In general, these records are considered reliable for purposes of vegetation analysis (Curtis 1959, Grimm 1984, Whitney 1986).

THE VEGETATION TENSION ZONE IN MICHIGAN

Geographers and ecologists have long been interested in the transition zone between southern deciduous forest and northern mixed coniferous-deciduous forest in Michigan's Lower Peninsula (Braun 1950, Odum 1971, Hushen et al. 1966, Kapp 1978, Brewer 1982). This region of forest transition trends northeast-southwest between Saginaw and Muskegon with its position generally paralleling Michigan state highway 46 (Potzger 1948).

The tension zone has been explained by two general arguments: limit of species ranges or soil geography. McCann (1979) concludes that this zone denotes northern range limits of numerous southern plant species, all influenced by insufficient heat during the growing season. In contrast, Elliot (1953) attributed varying community species composition across the tension zone to different soil characteristics, particularly acidity, texture, and related soil drainage.

This argument is tempered by considerations of human induced disturbances which have altered tension zone forest composition since European settlement. Therefore, assumptions about presettlement conditions based on correlating substrate with modern forest conditions may be incorrect.

Medley and Harman (1987) controlled for such error by relating soils distribution to *presettlement* tension zone forest composition. Using these data, they corroborated Elliot (1953) by finding significant relationships between soil texture and distributions of tree species across the tension zone in central Michigan. Unlike McCann (1979), the authors concluded that there is little evidence supporting a connection between climate and species transition.

Despite numerous tension zone studies west of Saginaw Bay, forest transitions in the Thumb are poorly documented, and given findings of Medley and Harman (1987), an examination of relationships between soils and forest geography east of Saginaw Bay may lead to new insights.

STUDY AREA

Physical Setting

Under edicts of the Land Ordinance of 1785 and Northwest Ordinance of 1787, the study area was surveyed over a 25-year span. Townships of eastern Genesee County were surveyed in 1815. Most of the region was assayed between 1820–1837 with the Saginaw Reserve survey of 1839 marking the end of this period. This General Land Office (GLO) Survey provided for division of unincorporated federal territory into six-by-six mile square (93 km^2) townships which were further subdivided into 36 sections each 1 mi^2 (2.6 km^2). As a result, the study area contains 117 townships encompassing approximately 10,435 km^2 (Figure 1).

Much of this region is relatively flat, low-lying lake plain bordering Lake Huron with elevations ranging from 175 m near the shore to 320 m in Lapeer County. Typical soils are derived from clay and silty lacustrine sediments. Most are somewhat poorly and poorly drained loams. However, much of Lapeer,

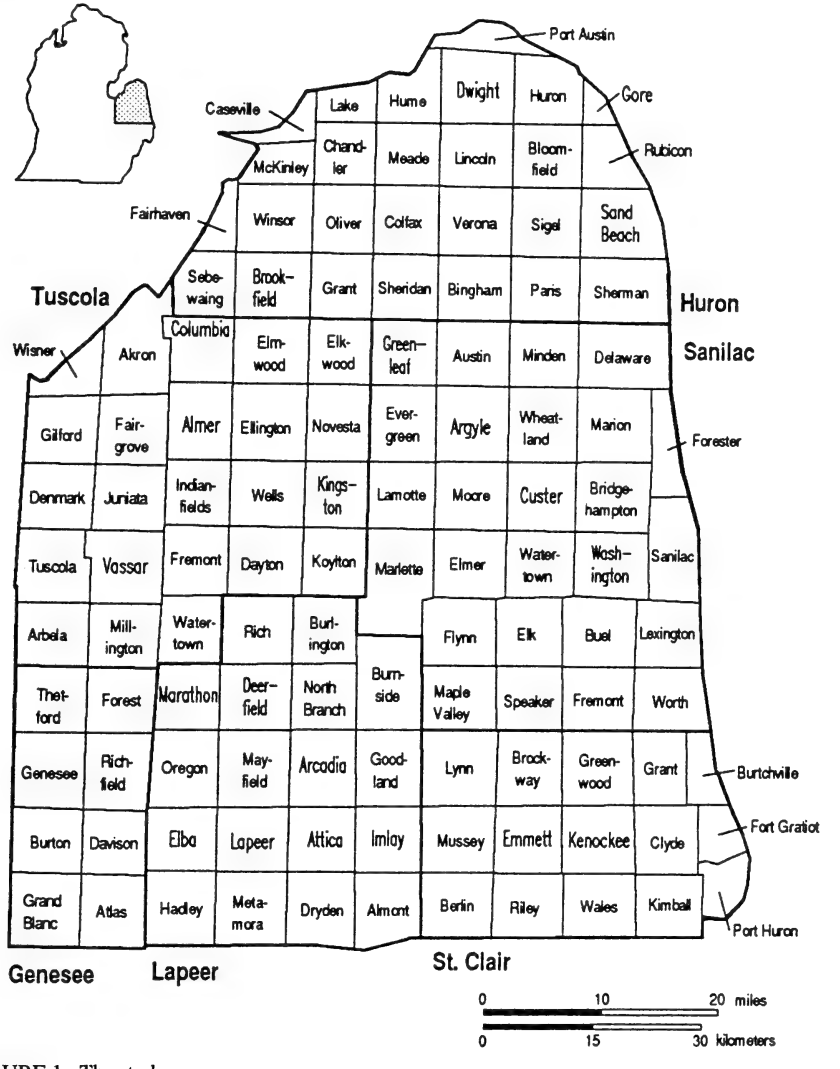

FIGURE 1. The study area.

Genesee, and southern Tuscola counties is characterized by medium to coarse-textured soils developed on ground moraine, end moraines, ice contact features, and outwash sheets. Poorly drained depressions are common on these landforms (Michigan State University et al. 1981, Farrand & Bell 1982, Albert et al. 1986). [For a general depiction of the Thumb's glacial geomorphology, see the glacial map of Michigan in Dorr and Eschman (1970, p. 160).]

Regional climate is humid continental with mild summers [Köppen Dfb type]. Mean annual temperatures range from 7 to 9°C with average decreasing northward through the peninsula. Relatively cool summer temperatures also are characteristic along the shores of Lake Huron and Saginaw Bay. Average annual

precipitation varies from 711 to 838 mm with greatest amounts falling along the eastern lake shore (Michigan Department of Agriculture 1974a, 1974b).

Presettlement vegetation in the Thumb area is difficult to reconstruct from present-day information because the contemporary landscape is predominantly farmland. In some counties, almost 90 percent of the total acreage is cleared of forest. What little woodland remains is much modified by human induced disturbances, including devastating and widespread wildfires, cutting, woodlot grazing, and soil drainage for improved agriculture. As a result, nearly all woodlands are disturbed or second growth (Holcomb 1972, Mettert 1986).

Previous Descriptions of Vegetation

Most descriptions of the Thumb's presettlement vegetation are brief and general, usually simply listing tree species within the presettlement forest (Schneider 1961, Holcomb 1972, Albert et al. 1986). Previous depictions of this region's vegetation are included either as part of maps showing all of Michigan (Marschner & Perejda 1946, Veatch 1959) or as part of the entire United States (Küchler 1964).

These Michigan vegetation maps are small scale, showing general presettlement vegetation types such as "hardwoods" or "mixed hardwoods & conifers" (e.g., Marschner & Perejda 1946). Nevertheless, there is general agreement that low, poorly drained topography was forested by hardwood and coniferous swamp communities. Drier terrain supported various mixtures of upland hardwoods and conifers (Marschner & Perejda 1946, Albert et al. 1986). Veatch's (1959) more detailed map shows a complex mosaic of presettlement forest communities within the Thumb. Mixtures of northern conifers and deciduous hardwoods were common on both uplands and wet lowlands. Where Marshner and Perejda (1946) had mapped a mixed hardwood-conifer forest in the northern Thumb, Veatch depicted a hardwood forest region.

Küchler's (1964) potential vegetation map portrays most of the Thumb as oak-hickory (*Quercus-Carya*) forest. This potential vegetation is "the vegetation that would exist today if man were removed from the scene and if the resulting plant succession were telescoped into a single moment (Küchler 1964, p. 1)." To Küchler, natural vegetation of the United States was present when white settlers appeared on the scene in the 16th to 18th century. Thus his "natural" vegetation equates to pre-European (or presettlement) vegetation. In any case, Barnes and Wagner (1981) concluded that Küchler's study is a fairly accurate description of presettlement Michigan vegetation despite numerous human impacts on regional ecology.

While different reconstruction procedures may explain contradictions on these maps, most of these authors seemingly underestimated the abundance of conifers in the Thumb's presettlement forest.[1] The following methods were devised to produce a better understanding of presettlement forest geography.

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[1]Patrick Comer of the Michigan Natural Features Inventory points out that Marshner and Perejda's (1946) map was more accurate in depicting Thumb vegetation than others. He thinks their qualitative map corresponds to the quantitative isoline map in this paper (pers. com.).

MAPPING THE TENSION ZONE

Data Collection

Among other tasks, 19th century surveyors were instructed to record species and diameters of blazed line and corner post trees, and distances of these trees from section corners (White 1983). This General Land Office (GLO) survey information (on file in the Michigan State Archives in Lansing) is the basis for this study.

Data were collected within townships (n = 117). Species were recorded on tabulation sheets for all bearing (or witness) trees associated with section corner and quarter section posts. However, trees situated along abutting township boundaries were not included in the samples to avoid possibility of twice counting trees that straddled township lines.

Data Processing and Analysis

For each township, number of observations for each tree species was tallied from the tabulation sheets. Total number of conifer observations was then determined for each township. Conifer relative density was calculated by dividing number (n) of coniferous trees by total number (N) of trees in each township (Brower & Zar 1977). These densities were assigned to corresponding geographic centers of all townships.

A map of conifer abundance in the Thumb was constructed with SURFER computer mapping software (Golden Software, Inc. 1989). SURFER produces isoline maps by interpolating between control points and associated data values, in this case township centers and conifer densities.

Results

Examination of the survey records produced a sample of 19,735 trees (mean = 166 trees per township). Six coniferous tree species were observed among a total of 47 different species recorded by GLO surveyors. These are eastern hemlock (*Tsuga canadensis* (L.) Carr.), tamarack (*Larix laricina* (Du Roi) K. Koch), northern white-cedar (*Tsuja occidentalis* L.), balsam fir (*Abies balsamea* (L.) Mill.), and undifferentiated "pine" (*Pinus* spp.)[2] and "spruce" (*Picea* spp.). Mean conifer density is 0.33 (n=177) with township values ranging from 0.0 to 0.70.

Closely spaced isolines in Figure 2 show a forest transition through the central Thumb. This spacing indicates a marked change in forest composition over

[2]Surveyors did not always identify species but often relied on general common names such as "aspen," "birch," "spruce" and sometimes "oak" when surveying the Thumb. Patrick Comer states that surveyors throughout Michigan normally used "pine" when identifying white pine (*Pinus strobus* L.) except in areas dominated by jack pine (*P. banksiana* Lamb.) (pers. com.). Based on my work with Thumb GLO notes, "pine" may occasionally indicate red pine (*P. resinosa* Alt.). Surveyors sometimes stated in their notes that they observed red pine along transect lines, for example in McKinley Township (T17N, R10E), where "Norway [red] & White Pine & Oak" were encountered.

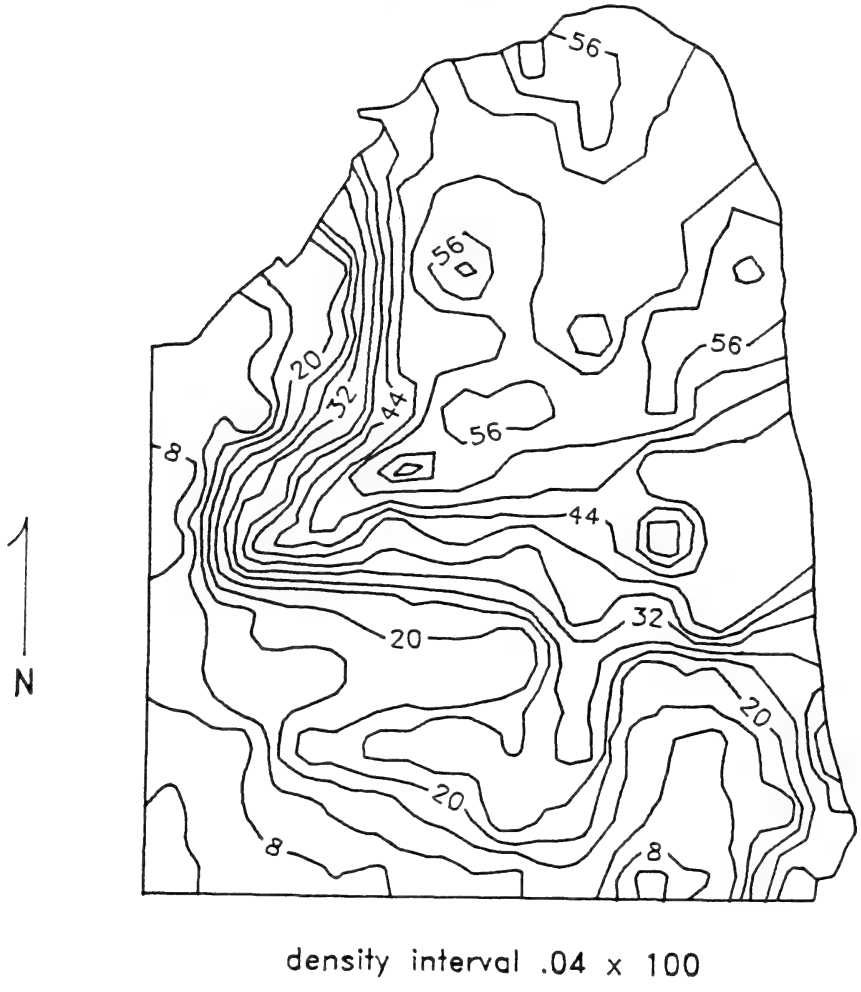

FIGURE 2. Coniferous species abundance in the presettlement forest, 1815–1839.

a relatively short distance—the tension zone. Conifers were more abundant in northern townships and eastern townships bordering Lake Huron. Areas south and west of the transition were covered primarily with deciduous forest.

SOIL-VEGETATION RELATIONSHIPS

Soil Data Collection

Soil data were also collected within townships. Fifty-eight Thumb townships were randomly selected for this purpose. Reducing the sample from the initial

117 townships decreased time of data collection while retaining sufficient size for statistical analysis. For each study area county, Soil Conservation Service (SCS) soil photomaps (e.g., Holcomb 1972) were sampled in an areal systematic fashion (McGrew & Monroe 1993) using a transparent dotted grid overlay. Soil mapping units falling beneath randomly selected dots were recorded within each sample township.

Data Processing

Soil mapping units were converted to Mokma's (1982) soil management units (SMU's) using his conversion tables. Unlike the SCS soil mapping unit, a soil management unit incorporates both soil texture and natural drainage class into one designation. Thus two variables—soil texture and drainage—are reduced to one, the SMU. For example, the Miami loam soil mapping unit is Mokma's soil management unit 2.5a—loam and silt loam with well to moderately drained conditions. This efficient soil management system was used effectively by Medley and Harman (1987) in their tension zone study. Proportion of each soil management unit within each township was then determined using: proportion = observations of SMU (xi) ÷ total observations (N).

Statistical Analysis

Multiple regression (Hintze 1987) was used to examine relationships between soil texture and drainage and conifer density. In this case, conifer density is the dependent variable (Y) while SMU proportions are the predictor variables (Xi).

Proportions corresponding to significant SMU's found in the regression were summed for each of the sampled townships (n=58). Next, three township groups were constructed: townships south (and west) of, in, and north of the tension zone. Sample townships were judged as "in" when approximately 50 percent or more of a township lay within the zone of closely spaced isolines.

Then Student's t Test (Hintze 1987) was utilized to compare these groups' SMU means in order to assess differences in soils across the tension zone.

Results

The soil sample produced 14,422 observations with a mean of 266 per township (n=58). SCS soil mapping units were converted to 37 soil management units (SMU's). Only 7 of these 37 were identified by regression as significantly related to conifer density (Table 1). Most of these soils are relatively poorly drained coarse-textured soils and were positively correlated with conifers in the presettlement forest. In general, conifers were more abundant where these poorly drained sandy soils are relatively common.

Townships south and west of the tension zone (n=21) have a mean proportion of 0.08 for these 7 significant SMU's. Townships in (n=19) and north (n=18) of the forest transition have higher respective averages, 0.22 and 0.15.

Student's t Test shows that there are significant differences in these group

TABLE 1. Multiple regression summary. Column 1 represents textures and natural drainage of significant Soil Management Units (Mokma 1982) entered into the stepwise regression.

$\log (Y + 1) = \log (X_i)$

$r^2 = 0.51$ $F = 0.74$ Probability < 0.001

X_i	std. regression coefficient	r^2 - add[a]	t-value	probability
somewhat poorly drained sand loam	0.31	0.08	2.9	0.006
well and moderately well drained loamy sand	–0.43	0.12	–3.5	0.001
poorly and very poorly drained loamy sand	0.25	0.05	2.3	0.03
muck and peat	0.45	0.16	4.0	0.0002
somewhat poorly drained[b] sand and loamy sand over loam and clay loam	0.43	0.13	3.7	0.001
somewhat poorly drained and very poorly drained sand	0.41	0.13	3.6	0.001
somewhat poorly drained loamy sand and loamy sand over clay[b]	0.26	0.06	2.4	0.02

[a]amount of r^2 added or removed by inclusion or removal of X_i
[b]"two-storied" soils with coarse-textures overlying finer-textured materials

means between townships north and south as well as townships in and south of the tension zone (Table 2). In both cases the two-tailed test reveals northern and transitional townships have means greater than the southern group. But there is no significant difference between group means in and north of the tension zone. Thus poorly drained coarse-textured soils are more common in and north of the tension zone and less abundant south and west of this transition.

DISCUSSION

Soil-Vegetation Relationships

Results of my study correspond in part with Medley and Harman's (1987) findings concerning central Lower Peninsula forest geography. In both cases needleleaf trees were more frequent on coarse-textured soils. Both investigations show the tension zone marks a vegetation transition and a significant increase in frequency of sandy soils northward through the ecotone. These results confirm Livingston's (1903, 1905) and Veatch's (1953, 1959) conclusions linking increased abundance of conifers northward through the Lower Peninsula with more widespread coarse-textured materials.

However, there are some differences between these two studies. Medley and

TABLE 2. Results of two-tailed t-test of group means for statistically significant Soil Management Units (see Table 1). Township groups are those north, south, and within the tension zone.

	$H_0: U_1 = U_2,\ H_1: U_1 > U_2$					
Township Group ID:	Northern vs. Southern		In vs. Southern		Northern vs. In	
No. of Townships:	18	21	19	21	18	19
Mean Proportion:	0.15	0.08	0.22	0.08	0.15	0.22
t-Value:	2.43		2.55		−1.32	
Probability:	0.02		0.02		0.2	
df:	24		20		25	
	reject H_0		reject H_0		accept H_0	

Harman (1987) speculated that low moisture holding capacity of coarse-textured soils and associated drought are related to conifer abundance in central Michigan. Because soil geography of the Thumb differs from that of central Michigan, my initial hypothesis assumed that fine-textured, relatively poorly drained, and presumably cold soils on extensive lake plains would account for increased conifer abundance in the northern Thumb. But my results were unexpected in that sand was more significantly related to needleleaf forest than either silt or clay. This is similar to Medley and Harman's results, but differs in that *poorly drained* coarse-textured soils are significantly related to presettlement forest geography in the Thumb.

These poorly drained soils help explain why the Thumb's forest geography was different than that of the central Lower Peninsula. In contrast to the pine forests of central Michigan (see Medley and Harman 1987), pines were less common throughout the Thumb (relatively density=0.05) than either hemlock (rd=0.17) or northern white-cedar (rd=0.06). Hemlock and northern white-cedar, along with tamarack, were all once abundant north and east of the Thumb's tension zone (Dodge 1989). Because hemlock and northern white-cedar have generally greater tolerance of poorly drained soil conditions than do the pines (Fowells 1965, Barnes & Wagner 1981), hemlock and cedar probably had a competitive advantage over pines on the extensive poorly drained soils of the Thumb.

Climate-Vegetation Relationships

Despite the demonstrated connection between vegetation and soil, the position of the Thumb's tension zone is more complex than soil geography alone can explain, since only about 50 percent of the variance is explained by regression.

The tension zone trends along the Lake Huron shore because distributions of hemlock and northern white-cedar parallel the lake, extending southward within a zone less than approximately 16 km wide. A possible explanation of this pattern is climate. Lake-moderated climate may favor conifers, especially during summer months when the near shore area is cooler and more humid than central Thumb townships.

The ranges of hemlock and northern white-cedar also extend southward in a similar fashion along the Lake Michigan shoreline (Fowells 1965). Harman

(1970) hypothesized that cooler temperatures and higher humidity near Lake Michigan reduce evaporation, thereby producing a local climate favorable to conifers. Cool and moist onshore airflow may also explain prevalence of conifers proximal to prevailing winds on Lake Michigan islands (Harman & Plough 1986). Similar relationships between water body exposure, temperature, humidity, and species composition are found in Maine, where red spruce (*Picea rubens* Sarg.), balsam fir, and white spruce (*P. glauca* (Moench) Voss) dominate the coastal forest east of Casco Bay (Davis 1966). Given these studies, analogous work in the Thumb region may yield rewarding insights about relationships between conifer geography and climate.

Disturbance-Vegetation Relationships

Natural disturbances played a role in presettlement forest ecology. GLO surveyors observed large areas of windthrow throughout the Thumb. Descriptions such as "windfall entirely swept down," "tremendous windfalls," "considerable timber down," and "windfall from tornado of autumn 1832" attest to the impact of wind as an agent of change.

Fire, too, was recorded in the GLO notes although its effect within the Thumb was apparently not as pronounced as that of wind. In Genesee County, surveyors' remarks included "fallen burnt timber," "burnt timber land," and "timber has been burnt." Forest fire scars were also seen in Lapeer County's "poor burnt oak lands."

Although causal relationships between these natural disturbances and presettlement forest development are beyond the scope of this paper, surveyors' observations concerning wind and fire may prove useful in future studies of Michigan's early 19th century forest.

CONCLUSIONS

A vegetation tension zone, or ecotone, trends generally northwest to southeast through Michigan's Thumb area. Conifers were more abundant to the north and east of this transition. Soil texture and natural drainage, especially poorly drained coarse-textured soils, are related to this forest geography. These soils are more common in and north of the tension zone and are related both geographically and statistically with increased conifer abundance within the presettlement forest.

ACKNOWLEDGEMENTS

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LONICERA MAACKII (CAPRIFOLIACEAE) NATURALIZED IN WISCONSIN

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Lonicera maackii (Rupr.) Maxim., the Amur honeysuckle, a shrub native to eastern Asia (Ohwi 1965, Rehder 1903), has been introduced into North America, where it escapes and is becoming locally established. Similar in ways to the Tartarian bush honeysuckle complex (see Green 1966), it is characterized by very short peduncles and acuminate leaves. Gleason and Cronquist (1991) report it as occurring "in N.Y., Md., Ky., and O." (p. 509); Pringle (1973) reports it from Ontario, Canada (a reference missed by Scoggan 1979), where herbarium records date back to 1955; and Wherry et al. (1979; cf. also the up-to-date treatment of Rhoads & Klein 1993) map it for a number of localities in Pennsylvania, suggesting that it might occur elsewhere in the East as well. In the Midwest, the species seems to have been collected most extensively in the northeastern sector of Illinois, judging from the map published by Mohlenbrock and Ladd (1978). More recently, it has been reported from Wisconsin (Swink & Wilhelm 1979; cf. also the fourth edition of 1994), Michigan (Barnes & Wagner 1981), Missouri (Mühlenbach 1983), and Kansas (Brooks 1986), but apparently not yet from Minnesota (Ownbey & Morley 1991), Iowa (Eilers & Roosa 1994), or Indiana (Crovello et al. 1983), where it has been found (see paragraph below citing Iltis's collection). There is no mention of it at all in *Rhodora* or in the *Bulletin of the Torrey Botanical Club* (except for a single non-floristic reference in the latter).

Although two early collections of *Lonicera maackii* from the University of Wisconsin campus in Madison (*R. Ellis s.n.*, Jun 1927, WIS; *P. Hawkins s.n.*, 12 Jun 1927, WIS) undoubtedly represent ornamental plantings (perhaps the very same shrub), spontaneously occurring *L. maackii* is now to be found on the campus, e.g., next to Lakeshore Path in the vicinity of the lakeshore dormitories, where several shrubs were discovered by Tom McFarland (*s.n.*, 27 Sep 1979, WIS) east of Tripp Hall and where a single shrubby treelet 3.5 m tall was observed by Hugh Iltis on 26 Jul 1992. Salamun (1980) states that it had been seen as an escape in several southern counties, but implies that *L. maackii* was still unvouchered for Wisconsin. Not until the late 1960's and 1970's were naturalized plants collected in Wisconsin, and over the past four years several more collections have been made, mostly in southwestern counties.

In Wisconsin *Lonicera maackii* was first collected on 31 July 1967 as an apparent escape along the railroad between N. Randall Ave. and N. Mills St., Madison, by a student (*S. Dolar s. n.*, OSH).

Lonicera maackii was next collected on 25 Aug 1977 from an "old pasture hillside" 3 mi. SE of Richland Center, Richland County, by Michael Nee (*15898*, MIL, UWM, WIS). A single large shrub 3.5 m tall was found on a S-facing slope together with a few trees of *Juniperus virginiana, Quercus alba,* and *Celtis occidentalis*. According to supplementary notes of the collector, the site had been heavily pastured for decades up until about 10 years prior to the time of collection.

The next vouchered station is 3 mi. W of Lake Geneva at the corner of Hwy. 50 and Chapin Rd., Walworth County (*G. Wilhelm & D. Ceisel 4685*, 28 Jun 1978, MOR), the basis for the first published report from Wisconsin (Swink & Wilhelm 1979). Wilhelm tells me that he found *Lonicera maackii* to be abundant in woods along Mallard Ridge west of Lake Geneva and suspects that it very probably occurs in Racine and Kenosha counties as well.

In June 1990 McFarland (*s.n.*, 15 Jun 1979, WIS) brought a specimen to the University of Wisconsin-Madison Herbarium for confirmation, thinking that it was the same honeysuckle he had collected earlier. It came from a single large shrub 1.5 m tall at the edge of a ridgetop oak woods E of Co. Hwy. G and N of Bowers Rd., 10 mi. due S of Muscoda in Grant County. McFarland revisited the property that summer and made additional specimens (*s.n.*, 23 Jun 1979, UWM, WIS; *s.n.*, 15 Sep 1979, WIS).

The next specimen was brought in by another student, Timothy Burger (*s.n.*, 12 Jul 1990, WIS), from an oak-aspen-hickory stand with a dense shrub layer in spots on fine sandy loam along the S side of Ember Rd. about 0.5 mi. E of Co. Hwy. M, 3 mi. S of Westfield, Marquette County.

A visit to "Savanna Hill Farm" in 1992 by Andrew Williams (*92–98*, 7 Sep 1992, WIS) turned up a small population of *Lonicera maackii* in the brushy understory of a ridgetop oak opening N of Indian Trail Rd., halfway between Indian Lake and Co. Hwy. K, 5 mi. due N of Cross Plains, Dane County. The shrub layer of this savanna, which is particularly noteworthy for its large-sized bur oaks and shagbark hickories, was very dense owing to to a history of grazing, but the collector does not remember that Amur honeysuckle was especially frequent.

On an outing of The Prairie Enthusiasts (TPE) in Crawford County in 1993 I collected specimens from a single large shrub 3 m tall in a small, glade-like patch of woody vegetation on the crest of an unnamed dolomite-capped ridge E of Hughes Rd. overlooking Citron Valley, 1 mi. due W of Barnum (*T. Cochrane & A. Williams 12914*, 20 May 1993, GH, MIL, NY, WIS). Noteworthy associates were *Juniperus virginiana*, the most common tree, *Zanthoxylum americanum*, an especially common shrub, as well as *Prunus serotina, Rubus occidentalis, Apocynum sibiricum,* and *Hypericum perforatum. Populus* and *Ulmus* saplings were making an appearance, and the habitat, surrounded by a good-quality, albeit formerly grazed, dry prairie remnant, was growing up to brush.

The most recent Wisconsin record is a collection from a hedgerow on Vale Prairie, a TPE property between (W of) Schneeberger and (E of) Silver rds., 4.5 mi. due SE of Monticello, Green County, made by Williams (*93–254*, 11 Oct 1993, WIS). Consistent with other Wisconsin sites, it was rare; only one large shrub 2.4 m tall and 3.0 m wide was found, associated with the usual southern

Wisconsin fencerow species, such as *Prunus serotina, Pyrus ioensis*, and *P. malus.*

At most Wisconsin sites, *Lonicera maackii* occurs in thin prairie soil over dolomite in semi-shaded fencerows, weedy thickets, and brushy groves; it occurs less frequently in woods. The plants are large and presumably old, but considering the long history of abundant botanizing in southern Wisconsin, the species may well be only recently established; otherwise, it would have been collected in earlier years. Since it is now present as far north as central Wisconsin, this shrub will no doubt continue to spread and become a well-established, but hopefully not pestiferous, member of the state flora. As is true for other introduced honeysuckles in the U.S., *L. maackii* has become a problem in disturbed woods and prairies elsewhere. Thus, Swink and Wilhelm (1994) state that "It would be difficult to exaggerate the weedy potential of this shrub," which at the time of the first edition of their flora (Swink 1969) already had been a weed for 40 years at the Morton Arboretum, at Lisle in DuPage County, Illinois. A lengthy growing season is frequently cited as contributing to the success of invasive shrubs. An extraordinarily long period of active growth has been documented for *L. maackii* in southwestern Ohio (Trisel & Gorchov 1994). Trisel (1993) has been studying the effectiveness of clipping regimes and stump removal in killing or controlling regrowth of this shrub.

On a visit to Indianapolis, Indiana, in 1987 Iltis collected *Lonicera maackii* from the campus of Butler University (*H. Iltis & O. Loucks 29733*, 13 Jun 1987, WIS). He observed impenetrable thickets of this *Lonicera* on moist and mesic slopes going down to the White River Canal both on the campus and all through north Indianapolis, the vigorous shrubs forming a solid understory that would be as problematic to control as the one produced by the *L. morrowii* × *L. tatarica* (*L.* ×*bella*) hybrid swarm that has bedeviled the University of Wisconsin Arboretum woods in Madison for half a century (Barnes & Cottam 1974; see also Hauser 1966). That no specimens were found in the Butler University Herbarium reflects the one great problem with dating and documenting such introductions, namely the reluctance of taxonomists to collect cultivated (and hence escaped) material. Poorly represented weedy plants offer perhaps the best argument for accepting and incorporating student collections into herbaria: ignorance of the species collected can yield a decided scientific benefit.

ACKNOWLEDGMENTS

I thank Susan Shapiro, Collections Manager at MIL, Gerould Wilhelm, Field Research Taxonomist at MOR, and Neil A. Harriman, Director at OSH, for checking for possible records in their collections; Orie L. Loucks, Ohio Eminent Scholar of Ecosystem Ecology at Miami University, for providing a literature reference; and Hugh H. Iltis, Director Emeritus at WIS, for reading the manuscript.

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ADDENDA

Subsequent to the submission of this manuscript, a significant new study has been published which specifically discusses the introduction, escape, and naturalization of *Lonicera maackii* in North America: Luken, J. O. & J. W. Thieret, 1995. Amur honeysuckle (*Lonicera maackii*; Caprifoliaceae): Its ascent, decline, and fall. Sida 16: 479–503.

Meanwhile, the author and others have made additional collections of *Lonicera maackii* at various localities in Wisconsin, among which is the first record for Milwaukee County. In view of the problems presented by weeds, especially by naturalized members of *Lonicera*, it may be useful to update the known distribution of *L. maackii*, which so far is limited to the southern one-third of the state.

Additional Specimens Examined (herbarium abbreviations follow Holmgren et al. 1990): WISCONSIN. CRAWFORD CO.: steep, oak-covered, W-facing slope overlooking Mississippi River, with small *Tilia americana, Acer saccharum, Cornus alternifolia, Vitis, Parthenocissus, Rubus occidentalis, Sanguinaria canadensis*, and *Ranunculus abortivus*, "NO OTHER *Lonicera* spp. in nearby woods," [4 mil. SE of Ferryville,] Sec. 26, T10N, R6W, 13 May 1994, *A. Williams 94–7* (WIS). DANE CO.: three shrubs (large-, medium- and seedling-sized) on lower N-facing slope of E end (collected specimens) in southern mesic forest of *Tilia americana-Ostrya virginiana-Betula papyrifera-Quercus alba* on well-drained, sandy, fine silt loam, six large- and small-sized shrubs on crest at W end (observed) in *Acer saccharum* forest, and one medium-sized shrub under an isolated *Tilia americana* tree in parking lot (observed), Center Bluff, S of Spring Creek and W of Springfield-Lodi Rd., 3 mi. SSW of Lodi, SW1/4 SW1/4 Sec. 4, T9N, R8E, 27 May 1994, *T. Cochrane & B. Cochrane 13196* (MIL, MOR, WIS); oak-hickory savanna, degraded through grazing, several shrubs to 2.5 m. tall, [S of Hwy. 19 between Marxville and Martinsville,] SW1/4 Sec. 11, T8N, R7E, 7 Sep 1992, *A. Williams 92–98* (WIS). GRANT CO.: E side of Good-Nuf Hollow Rd. just before first stream crossing, 2 mi. W of Co. Hwy. VV, Eagle Valley Nature Preserve, SW1/4 NW1/4 Sec. 35, T4N, R6W, 11 Jun 1993, *M. Anderson 93* (WIS); "a lot of it here in brushy edge of active pasture," N of Dry Hollow Rd. at Co. Hwy. A, [Bagley,] SW1/4 Sec. 16, T5N, R6W, 19 Jun 1994, *A. Williams 94–78* (WIS). MILWAUKEE CO.: one damaged shrub noted in fenced-off muddy path, highly disturbed deciduous woods on gentle springy slope, the tree layer of *Ulmus americana-Fraxinus pennsylvanica-Acer negundo*, the shrub layer one massive thicket of *Lonicera* cf. *morrowii* and *Rhamnus cathartica* (both very abundant) with *Staphylea trifolia* (occasional), the conspicuously depauperate groundlayer with *Glyceria striata* and *Urtica dioica* ssp. *gracilis*, lower end of "Bog Garden Walk," Boerner Botanical Gardens, Whitnall Park, Hales Corners, NW1/4 SE1/4 SE1/4 Sec. 32, T6N, R21E, 12 Jun 1994, *T. Cochrane & B. Cochrane 13223* (WIS).

EDITORIAL NOTICE: LIST OF REVIEWERS

I wish to thank (both for myself and on behalf of my editorial predecessors) the following individuals, who reviewed papers for Volume 33 (1994). Their volunteer efforts make possible the continued high quality of the papers in this journal.

Joseph Ammirati
Barbara Andreas
Richard Brewer
Cristopher Campbell
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William Crins
Garrett Crow
Gary Hannan
Donald Les
John Morton
Robert Shaffer
Welby Smith
Michael Vincent
Ellen Weatherbee
Daniel Wujek

Addenda and Errata: Violets of Michigan (Vol. 33, No. 4)

ACKNOWLEDGEMENT OF ADDITIONAL PUBLICATION SUPPORT

In addition to generous support of publication costs of the "Violets of Michigan" by the J. J. Davis Fund of the Department of Botany, University of Wisconsin-Madison, further assistance was recently provided by the C. R. and F. N. Hanes Fund of Michigan and the E. K. and O. N. Allen Fund of the University of Wisconsin-Madison Herbarium. The author expresses sincere thanks to the governing boards of these agencies, without whose financial support the violet treatment could not have been published.

NEW TREATMENT AVAILABLE FOR THE STEMLESS BLUE VIOLETS

Following publication of "Violets of Michigan", a thorough morphological phylogenetic study and treatment of the stemless blue violets (subsection Boreali-Americanae) and putative relatives has been completed as a doctoral dissertation at the University of Michigan by Nir Gil-Ad. Dr. Gil-Ad is currently preparing the dissertation for publication. The treatment and revised classification (as well as the complete bibliography) are critical to those interested in pursuing the Boreali-Americanae group beyond the cursory and preliminary sketch presented in "Violets of Michigan" and will be useful for a broader understanding of the genus in North America.

The complete title is: Systematics and evolution of *Viola* L. Subsection *Boreali-Americanae* (W. Becker) Brizicky. 1995.

ERRATA

Certain grammatical mistakes, omissions and prior concepts were unfortunately carried through several revisions and review cycles. The author accepts full responsibility for these errata and would be grateful to learn of others.

p. 150, first stanza of couplet 15, line 6 from top, and second stanza of same couplet, line 12 from top, strike out "than"

p. 150, first stanza of couplet 17, line 17 from top, insert semicolon after "serrate"

p. 152, second stanza of couplet 26, line 9 from top, strike out one of the "sepals"

p. 169, COMMENTS under *Viola blanda*—follow last sentence in paragraph 2, on line 14 from top, with: "Midwestern populations may be segregated as var. *palustriformis* A. Gray"

p. 171, synonyms under *V. macloskeyi*—replace author "DC." with "Ging."

p. 181, COMMENTS under *V. affinis*—in paragraph 2, on line 13, replace "between the two subspecies" with "with"; on line 21 from top, strike out "and seeds"

p. 186, COMMENTS under *V. pedatifida*—on line 39 from top, replace "*V. palmata* var. *angellae*" with "*V. ×subsinuata*"

p. 192, COMMENTS under *V. sororia*—on line 32 from top, replace "criticized" with "cultivated"

p. 195, correct authorship of *V. ×subsinuata* to "(Greene) Greene (pro sp.)"; add to synonymy *V. emarginata* var. *subsinuata* Greene, Pittonia 3: 313. 1898

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THE BIG TREES OF MICHIGAN
8. Quercus rubra L.

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Michigan's largest known red oak is located in the city of Saugatuck in Allegan County of Michigan's Lower Peninsula.

Description of the species: Oaks are members of the beech family, Fagaceae. Voss (1985) includes three genera of Michigan trees in this family: *Fagus*, represented only by *F. grandifolia* Ehrh. (American beech), *Castanea*, represented by *C. dentata* (Marshall) Borkh. (American chestnut), and *Quercus* (oaks), represented by seventeen species. *Quercus* can be distinguished from all other trees in our area by their distinctive cupped fruits, commonly known as acorns (Fig. 1). The leaves of oaks are alternate on the branch and range from entire to deeply lobed. The oaks are divided into two subgenera, *Quercus* (white oaks) and *Erythrobalanus* (red oaks),with *Quercus rubra* L. belonging to the subgenus *Erythrobalanus* (Voss 1985). The members of this subgenus can be distinguished by having acute leaf lobes with bristle tips and by acorns which ripen in their second season. The red oak is further characterized by its glabrous leaf undersurface, dull upper surface, coarsely toothed leaf lobes with oblique round sinuses, and by its shallow acorn cap, which encloses only the base of the nut (Fig. 1).

Location of Michigan's Big Tree: The largest red oak in Michigan is located in the front yard of 312 St. Joseph street in the city of Saugatuck in Allegan County. It is a distance of 39′ (11 m) from the edge of the road and bears an aluminum Michigan Botanical Club identification plaque signifying its State Champion status. The tree can be reached by taking Butler street north through the center of Saugatuck to Hoffman street. Turn right (east) and continue for two blocks to St. Joseph street and turn left on St. Joseph. The tree is located on the west side of the road and south side of the small red house near the corner of St. Joseph and Main streets.

Description of Michigan's Big Tree: The State Champion red oak appears to be healthy, despite a split at the base of the hollow main trunk. The circumference was measured on August 25, 1993 at 276″ (701 cm) [diameter = 88″ (224 cm)]. This represents an increase of 8″ (20 cm) from Thompson's (1986) measurements of 268″ (681 cm). The height was measured at 100′ (31 m), which is 15′ (5 m) shorter than Thompson's (1986) measurement.

The trunk of the tree diverges into 3 main trunks 2.5 m above the ground with fissures running down to the ground. The crown spread was measured at 87′

[1]Deceased 20 September 1994.

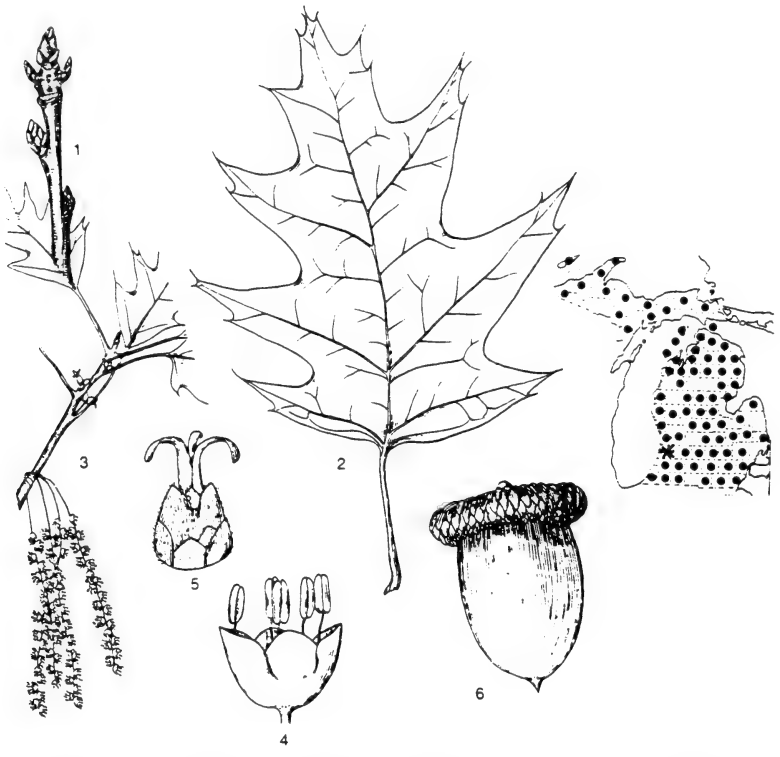

Figure 1. Documented distribution in Michigan and characteristics of the red oak. Map is from Voss (1985). The star indicates the location of Michigan's big tree. Drawings are from Barnes and Wagner (1981). 1. Winter twig, × 1; 2. Leaf, × 1/2; 3. Flowering shoot, × 1/2; 4. Male flower, enlarged; 5. Female flower, enlarged; 6. Fruit, acorn × 1.

(27m) with crown radii of 41′, 29′, 58′, and 45′. The 37% decrease in crown spread from Thompson's (1986) measurement of 139′ (42 m) will not remove its State Champion status since State Champion trees are determined by girth alone. The decrease in crown spread may be due to the pruning of several large limbs from the tree that were apparently encroaching on the house. Voucher specimens from this tree are filed in the Hanes Herbarium (WMU) and the herbaria at Michigan State University (MSC) and the University of Michigan (MICH).

INVITATION TO PARTICIPATE

If you would like to join us in extending this series of articles by visiting and describing one or more of Michigan's Big trees, please contact Elwood B. Ehrle for help with locations, specifications for taking measurements, and assistance with the manuscript. The Michigan Botanical Club encourages your involve-

ment in this activity. Please remember to ask permission before entering private property.

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NOTEWORTHY COLLECTION

OHIO

EQUISETUM SYLVATICUM L. (Equisetaceae). Woodland Horsetail

Previous knowledge. This species is known in recent times in Ohio from Ashtabula Co.: Conneaut Twp. 1979 & 1988, Harperfield Twp. 1980, Hartsgrove Twp. 1988, Richmond Twp. 1971 & 1988, Wayne Twp. 1983; Carroll Co.: Brown Twp. 1983; Geauga Co.: Burton Twp. 1980; Greene Co.: Beavercreek Twp. 1989; Summit Co.: Twinsburg Twp. 1960; and Trumbull Co.: Hartford Twp. 1979. The Natural Heritage Program data base also indicates it was known from Hocking Co., Benton Twp. 1975 and Stark Co., Bethlehem Twp. 1979 but these locations have been eliminated (Pat Jones, personal communication).

Significance. This collection documents a new county record for this potentially threatened species in the State of Ohio as determined by the Division of Natural Areas and Preserves (1994).

MAHONING CO.: next to farmer's field W of North Fork of Little Beaver Creek, S of St. Rt. 617. NW quarter of Sect. 33 of Springfield Twp. (T9N, R1W), 14 May 1994, *Chuey 17675* (YUO). A 1 meter by 2 meter colony next to cultivated field. Shaded by a Wild Black Cherry, *Prunus serotina* Ehrh., growing with Skunk Cabbage, *Symplocarpus foetidus* (L.) Nutt., and Marsh Marigold, *Caltha palustris* L.

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ODNR-Div. Nat. Areas & Preserves. 1994. Rare Native Ohio Plants : 1994–95 Status List. Columbus, Ohio.

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All of the 1994 issues (Vol. 33) were mailed May 12, 1995.
Volume 34, No. 1 (Jan. 1995) was mailed Aug. 17, 1995.

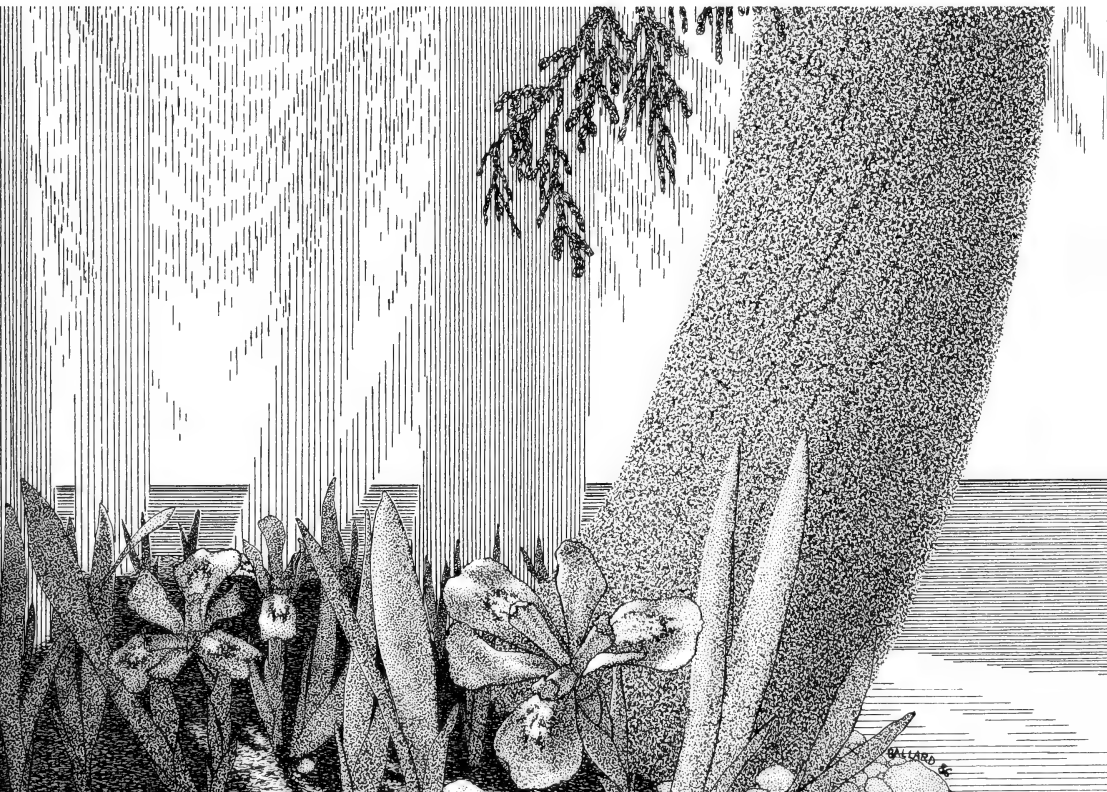
CONTENTS

On the cover: *"Cabbage Patch Kids" on a barefoot spring hike to see the "Hooded Leprechauns" of the swamp, skunk cabbage. Riverbend Natural Area of Grand River Park, Ingham Co. (S.W. of Lansing). April 2, 1995 Photo by Larry Lemanski*

Vol. 34, No. 3

THE MICHIGAN BOTANIST

May, 1995



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Articles dealing with any phase of botany relating to the Great Lakes Region may be sent to the Editor. In preparing manuscripts, authors are requested to follow our style and the suggestions in "Information for Authors" (Vol. 28, p. 43; Vol. 29, p. 143).

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Membership in the Michigan Botanical Club is open to anyone interested in its aims: conservation of all native plants; education of the public to appreciate and preserve plant life; sponsorship of research and publication on the plant life of the State; sponsorship of legislation to promote the preservation of Michigan native flora; establishment suitable sanctuaries and natural areas; and cooperation in programs concerned with the wise use and conservation of all natural resources and scenic features.

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ELEMENTAL COMPOSITION OF SOUTHWEST MICHIGAN MOSSES AS MEASURED BY NEUTRON ACTIVATION ANALYSIS

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ABSTRACT

The elemental composition of seven species of southwest Michigan mosses was examined via neutron activation analysis as a means of gauging elemental deposition from the atmosphere. The concentrations of 44 elements are reported and discussed in relation to concentrations in mosses reported in the literature. The data presented provide a preliminary view of possible concentration and deposition abnormalities in SW Michigan.

INTRODUCTION

Neutron activation analysis (NAA) has been recognized as an effective technique for measuring the concentrations of elements in many types of samples (Burgess 1985, Burgess & Hayumbe 1984). NAA was selected as the preferred technique for this study because concentrations of many elements can be measured concurrently in the ppm-ppb range (Burn 1988) from the same samples in a minimum of time. Mosses were selected since their morphology permits them to retain and accumulate elements from atmospheric deposition.

A previous study (Ehrle et al. 1992) measured eleven elements in southwest Michigan mosses by proton induced x-ray emission (PIXE) analysis. NAA is useful for many more elements than is analysis by PIXE.

In PIXE analysis, a proton beam from a linear accelerator is directed at a sample. Protons striking the atoms of the sample cause electrons in those atoms to occupy higher energy orbits. As the sample atoms return to a ground state, these electrons shift back to lower energy orbits. The excess energy is given off as x-rays, the characteristics of which are diagnostic for the elements involved. Further information on the nature and application of the PIXE process was given in Ehrle et al. (1992). In NAA, samples are lowered into the core of a nuclear reactor and bombarded with neutrons. Neutrons penetrate the nuclei of atoms, expelling protons and producing radioactive isotopes. As these isotopes return to ground state, they give off radiation, the characteristics of which are

diagnostic for the elements involved. In both PIXE and NAA, the resultant radiations are analyzed by computer. The computer program searches a library of radiation characteristics and prints out the elements present and their concentrations.

Important among the few studies applying NAA technology to bryophytes is its use by Steinnes (1980) to study atmospheric deposition of pollutants in different parts of Norway. Related studies by Wells et al. (1982) used NAA to analyze 15 elements in 78 aquatic and semi-aquatic plants from Michigan lakes, by Estabrook et al. (1985) to compare the heavy metal contents of shoreline and off-shore aquatic plants in Lake Huron, and by Dams et al. (1971) to analyze air pollution particles in Chicago and some parts of Michigan.

MATERIALS AND METHODS

Samples of seven species of mosses were collected from three locations in SW Michigan. The species were selected on the basis of certainty of identification, ease of access to the sites and the likelihood that the populations would endure, making follow-up studies possible. The microenvironments in which the mosses were growing are given in Table 1. Identifications were confirmed using collections from the Hanes Herbarium (WMU) where voucher specimens were deposited. Nomenclature was standardized to that of Crum (1985).

Several dozen individual moss plants were removed from each of the samples, examined at 20× and cleaned with a camel-hair brush to remove soil particles, leaf litter, and other macro-contaminants. With sub-aerial samples it is counterproductive to wash or rinse plants prior to analysis (Smith 1986). As Puckett (1988) points out, ". . . any pre-treatment which tends to remove deposited

TABLE 1. Location and environment of moss samples for neutron activation analysis. Abbreviations of moss species are used in subsequent tables. The Wolf Lake and Whiskey Run locations are in Van Buren Co., 11.5 miles W of Kalamazoo, MI. The Gourdneck location is in Kalamazoo Co., 2.0 miles WSW of Portage, MI.

Species	Collection #	Location	Environment
Atrichum angustatum (Brid.) BSG			
ATR 1	7218	Wolf Lake	Soil, knoll in pine plantation.
ATR 2	7221	Whiskey Run	Soil, streamside woods.
Climacium dendroides (Hedw.) Web. & Moh			
CLI	7222	Whiskey Run	Soil, streamside woods.
Leucobryum glaucum (Hedw.) Ängstr. ex Fries			
LEU 1	7225	Gourdneck	Soil, trailside in woods.
LEU 2	7231	Wolf Lake	Peaty soil in woods.
Mnium affine Bland *ex* Funck var. ciliare			
MNA	7230	Wolf Lake	Peaty soil in woods
Mnium cuspidatum Hedw.			
MNC	7229	Wolf Lake	Peaty soil in woods.
Polytrichum commune Hedw.			
POL	7217	Wolf Lake	Soil in woods
Thuidium delicatulum (Hedw.) BSG			
THU	7214	Whiskey Run	Rotting log in woods.

abiotic material of natural or anthropogenic origin will result in an underestimate of the metal deposition." When a sufficient number of plants had been examined and cleaned, they were oven-dried to a constant weight at 50°C. All specimen handling was accomplished using disposable gloves.

Neutron activation analysis of the samples was performed at the Ford Nuclear Reactor of the Phoenix Memorial Laboratory at the University of Michigan in Ann Arbor, MI.

The accuracy of the NAA analyses for a selection of elements was checked by including samples of National Bureau of Standards (NBS) Standard Reference Material (SRM) #1571 with each sample batch. SRM #1571 consists of orchard leaves gathered from an orchard near Lansing, MI that have been analyzed and certified by NBS. Since the NAA analysis of SRM #1571 is closely comparable to the composition determined and published by the National Bureau of Standards, it serves to verify the accuracy of the NAA analysis of the moss samples.

RESULTS AND DISCUSSION

The NBS-certified analyses compare favorably with those produced by the NAA system, thereby demonstrating the effectiveness and accuracy of that system. The values for potassium and manganese illustrate this well. The NAA readings are 14950 ±314 and 89.3 ±1.1, respectively. The nearly coincident NBS published values are 14700 ±441 and 91 ±4. The ± values for NAA and PIXE readings are computer-generated estimates based on standard error, the geometry of the radiation detectors, and several other variables.

The data in Tables 2 and 3 present the NAA measurements of 35 elements in seven species of mosses in southwest Michigan. Table 2 presents data on 15 elements whose concentrations exceeded 5.0 ppm dry weight and Table 3 on 20 elements present in concentrations of less than 5.0 ppm. The most abundant elements were potassium (avg. conc. 7856 ±312 ppm), aluminum (avg. conc. 2383 ±153 ppm), magnesium (avg. conc. 1659 ±207 ppm), and iron (avg. conc. 1053 ±107 ppm). Four elements were present in average concentrations at the level of hundreds of ppm as follows: chlorine (338 ±18), sodium (284 ±7), titanium (190 ±57), and manganese (169 ±2). Four elements (nickel, zinc, rubidium, and barium) were present at average levels from 33 to 82 ppm and three (chromium, iodine, and gadolinium) were present at less than 10 ppm.

Of the elements in Table 3, three (vanadium, bromine, and cerium) were present at average levels from 3.5 to 4.5 ppm, and four (ruthenium, silver, lanthanum, and mercury) at average levels from 1.1 to 1.8 ppm. The remaining 13 elements are present at levels of less than 1.0 ppm. Six elements (antimony, chromium, dysprosium, cobalt, hafnium, and thorium) are present at average levels from 0.402 to 0.963 ppm and five (uranium, scandium, samarium, ytterbium, and europium) at 0.106 to 0.280. The two elements of the 35 listed in Tables 3 and 4 that were present in the least measurable amounts were lutecium at 0.029 ppm and gold at 0.024 ppm.

Four elements were excluded from Tables 2 and 3 because they were detected only once in nine samples by NAA. These elements with their concentrations in ppm are selenium (3.27 ±1.224), molybdenum (1.08 ±0.523), tantalum (0.364 ±0.0855), and osmium (0.694 ±0.283). Five elements were detected in these same samples by proton induced x-ray emission (PIXE) analysis but not by NAA. These elements with their range and average concentrations in ppm

TABLE 2. Distribution of 15 elements present in concentrations greater than 5.0 ppm dry weight in seven species of SW Michigan mosses. Abbreviations of moss species are those given in Table 1. All values are given in ppm dry weight.

At.#	Elem	ATR 1	±	ATR2	±	CLI	±	LEU 1	±	LEU 2	±	MNA	±	MNC	±	POL	±	THU	±	Range where present	#times present	Avg.	±
11	Sodium Na	158	6	331	6	433	7	323	6	540	10	193	8	201	11	106	4	274	5	106–540	9	284	7
12	Magnesium Mg	1750	198	1370	163	1950	188	1050	163	1033	208	2540	275	2430	389	1040	135	1770	145	1033–2540	9	1659	207
13	Aluminum Al	1010	116	2160	122	2595	129	2040	120	4420	204	1480	172	1950	275	4340	139	1450	102	1010–4420	9	2383	153
17	Chlorine Cl	237	14	239	13	184	14	432	17	406	21	715	26	424	35	219	14	190	12	184–715	9	338	18
19	Potassium K	10900	311	7310	247	6160	242	4720	219	5315	271	15400	483	8970	616	6130	213	5800	209	4720–15400	9	7856	312
22	Titanium Ti	0	0	143	52	205	59	146	47	360	83	0	0	0	0	0	0	97	44	97–360	5	190	57
24	Chromium Cr	0	0	8	1	6	1	10	2	1	0	0	0	0	0	8	2	3	1	1–10	6	6	1
25	Manganese Mn	148	1	61	1	126	1	63	1	70	1	466	3	432	3	81	1	76	1	61–466	9	169	2
26	Iron Fe	721	89	903	107	1230	108	1395	140	2210	153	596	61	734	139	486	79	1200	88	486–2210	9	1053	107
28	Nickel Ni	38	11	0	0	0	0	0	0	31	12	30	8	0	0	0	0	0	0	30–38	3	33	10
30	Zinc Zn	69	5	0	0	31	4	35	5	46	5	54	4	71	6	26	4	33	3	26–71	8	45	5
37	Rubidium Rb	53	5	15	4	17	5	0	0	0	0	0	0	80	9	0	0	0	0	15–80	4	41	6
53	Iodine I	0	0	0	0	2	1	6	1	4	1	0	0	0	0	0	0	8	1	2–8	4	5	1
56	Barium Ba	77	21	0	0	81	19	48	19	156	26	53	12	79	24	0	0	0	0	48–156	6	82	20
64	Gadolinium Gd	0	0	0	0	0	0	0	0	5	2	5	2	0	0	0	0	0	0	5	2	5	2

dry weight are calcium (4539–23673, avg. 11291), copper (6–31, avg. 13), strontium (14–54, avg. 28), zirconium (9–84, avg. 23), and lead (9–140, avg. 47).

In summary, the concentrations of 44 elements are presented for SW Michigan mosses, 35 elements in Tables 2 and 3, four detected only once by NAA and five detected by PIXE analysis.

Soil samples were analyzed from each of the collecting sites. These analyses indicated that higher concentrations of a number of elements occur in the mosses than in the soils on which they are growing. Either the mosses are concentrating magnesium, chlorine, manganese, nickel, zinc, iodine, gadolinium, silver, and mercury from the soils, or mosses are collecting these elements from sub-aerial deposition more effectively than they are being incorporated into the soils, or both. Sub-aerial deposition would appear to be the sole source for nickel, gadolinium, and mercury, at least, since these elements were not found in any of the soil samples analyzed.

The pioneering studies of H.T. Shacklette established an interest in the elemental composition of mosses. Shacklette's (1965) paper provided data as percent of ash weight on eighteen of the elements studied here. Without knowing the precise relationship between ash weight and dry weight for each sample analyzed, it is not possible to convert his data to ppm dry weight. Erametsa and Yliroukanen (1971) report on rare earth elements in Finnish lichens and mosses. They present their data as percent of ash weight but include the percent dry weight, making it possible to convert their data, calculate average concentrations and compare them with those for SW Michigan along with Bowen's (1979) worldwide estimates for elements with atomic numbers 56 through 71 (Table 4). In this comparison, only gadolinium stands out as being significantly higher in Michigan. Most of the more recent literature expresses concentrations as ppm dry weight making conversions unnecessary.

The heavier elements have been little studied in mosses. We were unable to find a prior record of hafnium or gold in bryophytes, although Bowen (1979) does estimate the world average at 0.0022 ppm dry weight for gold as compared to 0.024 ppm in SW Michigan. There are a number of records of mercury in bryophytes in the literature. These include reports of 1.4 ppm by Yeaple (1972) in Wales; 0.06 and 0.09 ppm by Barkley-Estrup & Rinne (1979) in rural and near Thunder Bay, Ontario, Canada, respectively; 0.16 and 0.08 ppm by Steinnes (1980) in industrialized southern and rural northern Norway, respectively; 0.31 ppm by Percy (1982) in the Canadian Maritime Provinces; and 0.037 ppm by Pakarinen and Hansonen (1983) for Finnish *Sphagnum* bogs. Bowen's (1979) world estimate is 0.16 ppm in bryophytes. These results indicate that both Wales (1.4 ppm) and SW Michigan (1.33 ppm) have mercury levels in mosses substantially higher than those in Canada, Scandinavia, and other parts of the world. The only records of thorium and uranium in bryophytes are those of Steinnes (1980). He found 0.14 and 0.06 ppm for thorium and 0.10 and less than 0.03 ppm for uranium in southern and northern Norway, respectively. These compare with 0.402 ppm for thorium and 0.280 ppm for uranium in SW Michigan mosses, both substantially higher than Steinnes' findings.

Among the lighter elements, there are few reports on aluminum, chlorine,

TABLE 3. Distribution of 20 elements present in concentrations less than 5.0 ppm dry weight in seven species of SW Michigan mosses. Abbreviations of moss species are those given in Table 1. All values are given in ppm dry weight. Values given as 0.xyz ppm can also be read as xyz ppb.

At.#	Elem	ATR 1	±	ATR2	±	CLI	±	LEU 1	±	LEU 2	±	MNA	±	MNC	±	POL	±	THU	±	Range where present	#times present	Avg.	±
21	Scandium Sc	0.112	0.009	0.310	0.013	0.397	0.015	0.265	0.016	0.485	0.020	0.106	0.008	0.127	0.008	0.103	0.008	0.233	0.010	0.103–0.485	9	0.238	0.013
23	Vanadium V	1.7	0.6	3.1	0.6	4.4	0.7	4.4	0.7	7.0	0.9	0		0		0		4.2	0.5	1.7–7.0	6	4.133	0.683
27	Cobalt Co	0.502	0.083	0.169	0.082	0.657	0.110	0.491	0.103	0.707	0.176	0.255	0.061	0		0.373	0.068	0.470	0.081	0.189–0.707	8	0.453	0.096
35	Bromine Br	1.51	0.15	2.07	0.18	3.63	0.25	5.15	0.31	6.66	0.15	2.13	0.09	2.69	0.16	3.66	0.20	4.29	0.20	1.51–6.66	9	3.532	0.188
44	Ruthenium Ru	3.30	0.7	0		0		0		0		1.20	0.5	0		1.04	0.6	0		1.04–3.30	3	1.847	0.6
47	Silver Ag	0		0		0		0		1.55	0.359	0.978	0.244	1.87	0.506	0		0		0.978–1.87	3	1.466	0.370
51	Antimony Sb	0		0		1.18	0.33	0		0		0		0		0		0.382	0.138	0.382–1.18	2	0.781	0.234
55	Cesium Cs	0		0.415	0.125	0.579	0.122	0.398	0.141	1.156	0.162	1.66	0.117	0.754	0.160	2.25	0.141	0.498	0.085	0.398–2.250	8	0.963	0.130
57	Lanthanum La	0.54	0.05	1.36	0.06	1.81	0.08	1.45	0.08	1.94	0.06	0.74	0.03	0.80	0.04	0.43	0.04	1.33	0.06	0.43–1.94	9	1.156	0.056
58	Cerium Ce	0		3.87	1.09	6.07	1.05	0		0		0		0		0		3.56	0.967	3.56–6.07	3	4.50	1.04
62	Samarium Sm	0.063	0.011	0.222	0.009	0.290	0.012	0.213	0.013	0.300	0.008	0.071	0.004	0.118	0.008	0.077	0.010	0.212	0.007	0.063–0.300	9	0.174	0.009
63	Europium Eu	0		0.138	0.029	0.097	0.029	0.070	0.028	0.112	0.027	0.085	0.022	0		0		0.136	0.027	0.070–0.138	6	0.106	0.027
66	Dysprosium Dy	0		0		0.920	0.298	0		0.790	0.363	0		0		0		0		0.790–0.920	2	0.855	0.331
70	Ytterbium Yb	0		0		0.160	0.048	0.174	0.058	0.210	0.057	0		0.234	0.040	0		0.097	0.029	0.097–0.234	5	0.175	0.046
71	Lutecium Lu	0		0.018	0.007	0.029	0.008	0.030	0.008	0.043	0.008	0		0		0		0.029		0.018–0.043	5	0.029	0.007
72	Hafnium Ha	0		0.400	0.095	0.467	0.094	0.500	0.148	0.470	0.096	0.182	0.070	0		0		0		0.182–0.500	5	0.404	0.101
79	Gold Au	0.019	0.002	0		0.017	0.002	0.022	0.002	0.017	0.002	0.032	0.001	0.019	0.002	0.024	0.002	0.040	0.002	0.017–0.040	8	0.024	0.002
80	Mercury Hg	0		0		0.908	0.426	0		0		0		0		0		1.76	0.491	0.908–1.76	2	1.33	0.46
90	Thorium Th	0		0.435	0.125	0.404	0.136	0		0		0		0		0		0.366	0.113	0.366–0.435	3	0.402	0.125
92	Uranium U	0.285	0.128	0		0.278	0.097	0		0.277	0.081	0		0		0		0		0.277–0.285	3	0.280	0.102

TABLE 4. The rare earth and heavier element concentrations in mosses in Finland and SW Michigan compared with world estimates. All values in ppm dry weight. Finnish data are from Erametsa & Yliroukamen (1971) and world estimates are from Bowen (1979).

AT. #	Elem.	Finland	SW Michigan	World Estimates
56	Barium Ba	56.0	82.0	34–70
57	Lanthanum La	2.52	1.156	1.3
58	Cerium Ce	3.89	4.50	2.6
62	Samarium Sm	0.47	0.174	.35
63	Europium Eu	0.116	0.106	.05
64	Gadolinium Gd	0.47	5.0	2.7
66	Dysprosium Dy	0.34	0.855	0.31
70	Ytterbium Yb	0.178	0.175	.12–.250
71	Lutecium Lu	0.017	0.029	0.05

scandium, titanium, bromine, rubidium, ruthenium, antimony, and iodine in bryophytes. We were unable to locate any reports at all for chlorine, bromine, and ruthenium. If the continuing search fails to turn up any references, this paper provides the first record of these elements in mosses. For aluminum, the only other report is by Shacklette (1965) as percent ash weight. Horovitz et al. (1974) reported 0.56 ppm scandium in two species of mosses from German forests. Bowen's (1979) world estimate is 0.3–0.7 ppm. These figures compare with 0.24 ppm scandium in SW Michigan mosses. Only one record was found for titanium. Satake et al. (1987) provide data on aquatic bryophytes in Japan. From their data, an average concentration of 100 ppm can be calculated. The comparable figure for SW Michigan terrestrial mosses is 190 ppm which perhaps indicates a higher derivation of titanium from the soil than occurs in aquatic situations. Only Bowen's (1979) estimate of 21 ppm is available for rubidium compared with 41 ppm in SW Michigan. Additional studies in various parts of the world will be necessary before the significance of these figures can be assessed. The studies of Steinnes (1980) in Norway reported 0.86 ppm antimony for industrialized southern Norway and 0.07 ppm for rural northern Norway. If these figures are borne out by studies conducted elsewhere, it will suggest that the 0.78 ppm record for SW Michigan may indicate industrial

pollution. There is no adequate basis for assessing the 5 ppm iodine in SW Michigan mosses. The only record is that of Gurievich (1963) who reported 360-400 ppm iodine in bryophytes growing in association with iodine-rich waters in the Baltic region.

The record for cobalt in bryophytes includes Steinnes' (1980) findings of 0.64 ppm in southern Norway and 0.24 ppm in northern Norway. The SW Michigan finding of 0.45 ppm lies between these values. In a transect across Sweden, Ruhling and Tyler (1971) report cobalt values which average 1.4 ppm. In two species of forest mosses in Germany, Horovitz et al. (1974) found 1.3 ppm. It is not clear why the findings are substantially higher in Sweden and Germany than they are in Norway and SW Michigan. Local sources of industrial pollutants and/or local differences in soil concentrations may be involved. Further study will be necessary to determine if one or both of these can account for the measured differences.

The record for silver in bryophytes includes values of 0.02 ppm in New Zealand (Ward et al. 1977), 0.05 ppm in England and Germany (Jones et al. 1985 and Horowitz et al. 1974), and 0.04 ppm in northern Norway (Steinnes 1980). The consistency of these findings suggests that Bowen's (1979) world estimate of 0.01–0.88 ppm is accurate. The higher value of 0.32 ppm for industrialized southern Norway (Steinnes 1980) may suggest that the considerably higher value of 1.47 ppm for SW Michigan may be due, in part, to industrial pollution or some other cause. On the other hand, silver was found in only three of seven SW Michigan moss samples analyzed, and the values were inconsistent. Silver was found at 0.978 ppm in *Mnium affine*, 1.55 ppm in *Leucobryum glaucum*, and 1.87 ppm in *Mnium cuspidatum*. It was found in only two of five SW Michigan soil samples; 0.645 ppm in soils associated with *Atrichum angustatum* and 0.792 ppm in soils associated with *Mnium cuspidatum*. The presence of the highest values in *Mnium cuspidatum* and the soil associated with it suggests that the soil rather than atmospheric deposition may be the source. More studies of silver concentrations in both mosses and soils will be necessary before the situation can be clarified.

Although cesium is somewhat higher in SW Michigan than elsewhere at 0.963 ppm, this value is not entirely inconsistent with those reported in the literature. Steinnes (1980) found 0.79 ppm in southern Norway; Horowitz et al. (1974) recorded 0.44 ppm for forest mosses in Germany; and Bowen's (1979) world estimate is 0.8 ppm. The only record with significantly lower values is that of Steinnes (1980) for comparatively unpolluted northern Norway. While the data suggest that the values for SW Michigan may be due to industrial pollution, the figures do not yet justify this conclusion.

Of the elements studied here, the remaining nine have been most frequently reported on. Depending on the element, there are from seven to 25 references in the literature. These references have been listed in Table 5 to facilitate comparisons between what is known of elemental concentrations in mosses elsewhere with their concentration in SW Michigan mosses. Several of the papers listed provide data on mosses in areas known to be polluted as well as those thought to be pristine. Thus, Steinnes (1980) reports on values from industrialized southern Norway and rural northern Norway, and Thomas (1986) compares data

TABLE 5. Concentrations in ppm dry weight of the elements in mosses most frequently reported in the world literature compared with their concentrations in SW Michigan mosses. Values listed are derived directly from the references listed or are averages calculated.

References	Location	Na	Mg	K	V	Cr	Mn	Fe	Ni	Zn
1. Groet (1976)	NE U.S.					5			10	64
2. Barkley–Estrup & Rinne (1979)	Canada						290	692	2.0	71
3. Percy (1982)	Canada					1.2	245	353	1.5	24
4. Rinne & Barkley-Estrup (1980)	Canada						318	944	3.4	65
5. Aaby & Jacobson (1978)	Denmark	1747	1053	3179	9.1	3.5	97	1395	3.0	69
6. Johnson & Rasmussen (1977)	Denmark				10	9	480	2600	6	84
7. Pilegaard et al. (1979)	Denmark				16.9	7.0	185	2770	10.6	75
8. Rasmussen & Johnson (1976)	Denmark	700	1650	5000	7.5	3.0	165	2250		95
9. Damman (1978)	Sweden	580	490	3500			100	200		
10. Folkeson (1979)	Finland							956	4.5	190
11. Ruhling & Tyler (1971)	Sweden					6.5			6.3	117
12. Thomas (1986)	S. Sweden	340		3784			295	3215	17.4	97
13. Steinnes (1980)	S. Norway				8.5	3.8		750		72
14. Steinnes (1980)	N. Norway				1.2	1.0		350		31
15. Thomas (1986)	Spitzbergen	301		3203			69	1740	3.2	32
16. Folkeson (1979)	Finland				4.6	1.3	238	400	3.3	48
17. Bates (1982)	England		710	3610						
18. Jones et al. (1985)	England									100
19. Goodman & Roberts (1971)	Wales		1730						16	92
20. Horovitz et al. (1974)	Germany					5.3		1439		61
21. Kabat-Pendias&Pendias (1984)	Poland					2.4	178	612	1.8	73
22. Nagano (1972)	Japan		4090	2819						
23. Satake et al. (1987)	Japan		2668				87	408		49
24. Soma et al. (1988)	Japan	193	1980				26	640		
25. Smith (1986)	Alaska						700	2100		62
26. Onianwa et al. (1986)	Nigeria						289	6139		38
27. Onianwa & Egunyomi (1983)	Nigeria		4080				337		9.2	55
28. Ward et al. (1977)	New Zealand									17.2
Range of literature values		193–1747	490–2668	2819–5000	1.2–16.9	1.0–9	26–700	200–6139	1.5–17.4	17.2–190
Average of literature values		644	2050	3585	8.1	4.1	241.1	1497.7	6.5	70
Average of SW Michigan values		284	1659	7856	4	6	304	1952	33	45

from industrialized southern Sweden with that from comparatively unpolluted Spitzbergen. Both sets of values are included in Table 5. Although the references listed include mosses growing in a wide variety of different environments, the average values should bear an order-of-magnitude similarity with SW Michigan mosses. As Table 5 shows, this is generally the case. It is not known at this time why the average values for potassium, chromium, and nickel are significantly higher in SW Michigan than in most other places in which measurements have been made.

CONCLUSIONS

Neutron activation analysis and proton induced x-ray emission analysis were used to measure the concentrations of 44 elements in the same series of samples of SW Michigan mosses. Most other studies have been limited to studying many fewer elements, usually 4 - 6 and rarely more than 10 - 12. Furthermore, other techniques alter or destroy the sample, limiting these techniques to determining only one or a few elements in any single sample. NAA makes it possible to obtain data on many elements simultaneously from a single moss sample.

When compared with the world literature, the values reported for SW Michigan generally fall within the range of values obtained elsewhere. Furthermore, when average values for SW Michigan mosses are compared with general averages calculated from the world literature, there appears to be an order-of-magnitude correctness to the SW Michigan values.

Several elements have higher values in the SW Michigan mosses analyzed than in adjacent soils. These include magnesium, chlorine, manganese, nickel, zinc, iodine, gadolinium, silver, and mercury. Atmospheric deposition is suggested for at least nickel, gadolinium, and mercury since these were not found in any of the SW Michigan soil samples analyzed. Furthermore, nickel, gadolinium, and mercury stand out as being of higher concentration in SW Michigan mosses than in mosses analyzed elsewhere. The literature also suggests that the values for SW Michigan mosses may be higher than those reported from elsewhere for silver, chromium, potassium, antimony, thorium, and uranium.

It must be emphasized that these observations must continue to be preliminary until more studies are conducted around the world. There are still too few records in the literature to permit reliable generalizations.

Finally, further studies will be necessary in SW Michigan to assess the statistical variability related to the data reported here. Until these studies can be completed, the data herein stand as the only record in ppm dry weight for the mosses of the region. As more data become available for SW Michigan, it will be possible to draw a firmer baseline against which future changes can be measured.

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REVIEWS

TREES OF MICHIGAN AND THE UPPER GREAT LAKES, 6th Ed., Norman F. Smith. 178 pages. Thunder Bay Press, Lansing, Michigan. 1995. [ISBN: 1-882376-08-0] Price $21.95 US [Available from Thunder Bay Press, 720 E. Shiawassee, Lansing, Michigan 48912.]

This useful guide to the trees of Michigan was first published in 1948 as *Michigan Trees Worth Knowing* by the Michigan Conservation Department, now the Michigan Department of Natural Resources. It was revised and enlarged in 1952, 1961, 1970, and 1978. Its latest edition (1995) carries the work forward with all photographs in full color.

The photographs are superb throughout and show the general habit of each tree species along with its bark, leaves, flowers or cones, and seeds. The photographs are clear and detailed. They should be useful in tree identification throughout the Upper Midwest.

Eighty species are described and illustrated in 79 two-page essays (Wild Plum and Canada Plum are treated together but listed separately in the Table of Contents). These 79 essays make up most of the book. They are joined by a short introduction and short treatment of forest succession, scientific tree nomenclature, the arrival of autumn, firewood ranked by percent of heat, etc.

Each of the seventy-nine essays includes comments on the range of the species and description of the general size of the tree and the shape of its crown when grown alone or in a forest canopy. Descriptions are included of the bark on twigs and trunks, along with the nature of leaves, flowers or cones, fruits,

and seeds. Each essay ends with short comments on insect pests and diseases, selected characteristics of the wood, and uses to which the wood is generally put. Photographs are interspersed with text in each two-page treatment.

The essays are well constructed but are marred by the use of long dependent clauses at the beginnings of sentences. This is a more awkward construction than is desirable in a book of this type. It would also have been helpful if the author had cited relevant literature throughout the essays so that factual accuracy and currency could more readily be checked.

There are some statements that will bother most botanists. The essays on the conifers confuse cones, which they all have, with flowers, which none have. Thus statements like "The flowers of white pine occur as small cones" (p. 6) or the ". . . clusters of dark staminate flowers . . ." (p. 9) in red pine, are inappropriate. This error is repeated in the glossary entries for cone (p. 173). It is not a fruit. Furthermore, the definition of ovulate (p. 174) refers "to those flowers as in the conifers." Other errors are relatively minor. Contrary to Smith's claim, chambered pith cannot be seen in a cross section of twigs. A vertical or at least slanted section will be necessary. The seeds of *Ailanthus* (p. 169), or the elms and ashes for that matter, are not winged. The fruits are. The use of hippo in *A. hippocastanum* L. has nothing to do with horses. Neither does it in *Amaryllis hippeastrum* L. In both cases it only means large. "Horse-size" if you will.

The text would have profited by closer editing and proofreading. The most common type of error is the omission of a space, leading to words like nutwhich (p. 47), thenew (p.118), redoak (p. 117), branchesand (p. 125), limberand (p. 129), whichis (p. 134) areclear and onseparate (p. 148), someparts (p. 150), and maywinterkill (p. 168).

Perhaps the next edition will take care of these matters. All of the above not withstanding, it is a useful and delightful book. The photos alone are well worth the purchase price. This book has served well in the past and will continue to do so in the future. Meanwhile, if a new edition is prepared, this reviewer hopes it will include size and location data on Michigan's State and National Champion Trees. These data are readily available and should be included in a book of this sort.

——Elwood B. Ehrle, Chairman
Michigan Botanical Club Big Tree Committee

PLANTS OF THE CHICAGO REGION, 4th Ed. Floyd Swink & Gerould Wilhelm. Indiana Academy of Science, Indianapolis. 1994. xiv + 921 pp.

This new edition of a much-used manual, covering the area from southeastern Wisconsin around the south end of Lake Michigan to southwestern Michigan, is most welcome, with some notable improvements. The most obvious is the appearance of the book, beginning with the colorful dust jacket and extending to the new typeface, a great step forward from the rather crude-looking typewriter-like font of the previous edition. Re-examination of many specimens has resulted in the addition of 266 new taxa and over 2700 new county records

(and the removal of nearly 300 records found to be erroneous!). These additions have, in turn, resulted in revision of many of the keys. The earlier "Method for Environmental Assessment of Open Land", a way of using the "conservatism" or fidelity of native plant species to their natural habitats in order to assess the "integrity" of an area, has been renamed "Floristic Quality Assessment" and expanded considerably. The accompanying "Evaluation Checklist" of the flora includes not only the species' "coefficient of conservatism", but also their national wetland category, making this section doubly useful to those who are asked to evaluate "natural" areas. For those interested in numbers, the synopsis on the flora now includes some breakdown of the species by family, growth form (woody vs. herbaceous, shrubs vs. trees vs. vines, etc.), origins of introduced species, and other criteria. There is a new guide to the "Natural Divisions of the Chicago Region" (broken down primarily by physiography and soils), and a guide to the authors' concepts of the area's natural plant communities (including some writings from 19th-century sources on the presettlement vegetation). For those at an earlier stage of learning about the flora, the glossary now includes illustrations (a whole plate elucidating terms pertaining to leaf shapes, another to inflorescence types, etc.).

The distinctive alphabetical arrangement of genera and families may come as a surprise to new users of the book who are more accustomed to a taxonomic organization, but this method has its own advantages and disadvantages. The listing for each taxon still includes habitat information, an extensive list of associates, occasional taxonomic information, a map of county occurrences, and a range of flowering dates, as well as the national wetland category and coefficient of conservatism. The authors' "traditional" use of the nomenclature of Fernald's 1950 *Gray's Manual* will be distressing to many, but is at least partly ameliorated by their providing a list of synonyms for each taxon. To the list of sources for synonyms have been added Gleason and Cronquist's 1991 *Manual*, Mohlenbrock's 1988 *Guide to the vascular flora of Illinois*, and the first two volumes of Voss's *Michigan Flora*. Taxa below the species level are now listed explicitly as varieties (the authors recognize no subspecies or forms), but in the lists of associates these varieties are still denoted by undesignated trinomials (e.g., *Carpinus caroliniana virginiana, Prunella vulgaris lanceolata*). Regardless of these nomenclature niceties, this volume still represents a vast amount of floristic and ecological knowledge. This is, more than any other manual I know, very much an "ecologist's flora".

There are more detailed delights here, too, of language and of observation. Under *Ribes americanum*: "The student is encouraged to view, particularly on the lower leaf surfaces, the gorgeous, golden, globular, glistening, glittering glands." The urban nature of most of the region is summed up by the comment under *Allium tricoccum* var. *burdickii*: "The ripe seeds bounce beautifully on a concrete sidewalk."

——Barbara J. Madsen
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NEW AND NOTEWORTHY ONTARIO GRASS (POACEAE) RECORDS

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Dore and McNeill's (1980) excellent monograph is the standard source of information on Ontario grasses. The past decade has seen a great deal of botanical fieldwork in the province, particularly in the southern portion. McNeill (1981) reported *Apera spica-venti* (L.) Beauv. and *Apera interrupta* (L.) Beauv. new to Ontario, and Webber et al. (1985) added *Agropyron elongatum* (Host) Beauv., *Bromus squarrosus* L., *Distichlis stricta* (Torrey) Rydberg, *Poa sylvestris* A. Gray, and *Stipa comata* Trin. & Rupr. to the provincial flora. This paper documents further additions and updates information on the status and distribution of some Ontario grasses.

New records for 29 taxa are reported. Eight species and two hybrid grasses are new to Ontario: *Diarrhena obovata*, *Eragrostis capillaris*, *Muhlenbergia sobolifera*, *M.* ×*curtisetosa*, *Bromus* ×*pseudothominii*, *Elymus arenarius*, *Eriochloa contracta*, *Festuca gigantea*, *Puccinellia fasciculata*, and *Vulpia myuros*. The first four taxa appear native, while the remaining six taxa are adventive. We report significant range extensions for 19 grass species, eight of which are native (*Glyceria melicaria*, *Muhlenbergia uniflora*, *Panicum gattingeri*, *P. rigidulum*, *P. tuckermanii*, *Paspalum ciliatifolium*, *Poa sylvestris*, and *Sporobolus heterolepis*), and the remaining 11 adventive (*Agropyron elongatum*, *Alopecurus geniculatus*, *Apera interrupta*, *Aristida oligantha*, *Bromus squarrosus*, *Diplachne acuminata*, *Muhlenbergia asperifolia*, *Poa arida*, *P. bulbosa*, *Puccinellia nuttalliana*, and *Tridens flavus*).

These 29 grass taxa are listed alphabetically below. Nomenclature follows Dore and McNeill (1980) as closely as possible. Comments on taxonomy, nomenclature, identification, distribution, and ecology follow specimen citations. Herbarium acronyms follow Holmgren et al. (1990). Names of taxa introduced from Eurasia are preceded by an asterisk (*), and those introduced from elsewhere in North America by a plus sign (+). Taxa native to Ontario have no symbol preceding the name. Names of taxa new to Ontario are in bold. For species with many new records, not all specimens are cited or mapped. We have generally cited only one collection per township, usually the earliest.

* *Agropyron elongatum* auct. amer., non (Host) Beauv. (Tall Wheat Grass)

ALGOMA DISTRICT: Tiley Twp., Hwy. 17, E end of Batchawana Bay, about 45 km N of Sault Ste. Marie, several robust roadside clumps, 8 Jul 1989, *Oldham 9634 & Delisle-Oldham* (DAO, MICH, TRTE). **BRUCE CO.**: Arran Twp., Hwy. 21, 2.6 km E of Saugeen First Nation boundary, single robust clump along highway, 6 Sep 1991, *Oldham 13420* (DAO, MICH). **DURHAM REGIONAL MUNICIPALITY**: Cartwright Twp., Hwy. 7A, 1 km E of Nestleton Station, three clumps on roadside, 27 Jul 1995, *Oldham 17601* (DAO). **ELGIN CO.**: Yarmouth Twp., Hwy. 3, 100 m E of Hwy. 74 junction, several robust clumps in roadside ditch, 9 Aug 1986, *Oldham 6645* (DAO). **FRONTENAC CO.**: Olden Twp., Hwy. 7, 8-9 km E of the Salmon River, colony of 50-100 plants on open, grassy roadside, 6 Dec 1985, *Oldham 5668 & Delisle-Oldham* (DAO). **GREY CO.**: Bentinck Twp., Hwy. 4, 7.2 km W of Durham Post Office, single robust clump in roadside ditch, 18 Apr 1989, *Oldham 8937 & Woodliffe* (DAO, MICH, TRTE). **HASTINGS CO.**: Sidney Twp., Hwy. 401 at County Road 1 (interchange 538), 5 km W of Belleville, single clump on S roadside, 31 Oct 1994, *Oldham sight record*. **HURON CO.**: Town of Goderich, 100 m N of Hwy. 21 bridge over Maitland River, several roadside clumps, 15 Jul 1987, *Oldham 7645* (DAO, MICH); Stephen Twp., Hwy. 21, 4 km NE of Grand Bend, single roadside clump, 26 Jul 1987, *Oldham 7699 & Delisle-Oldham* (DAO). **LAMBTON CO.**: Enniskillen Twp., 3.5 km W of Oil City, scattered clumps along Hwy. 80 near Sideroad 9, 25 Jul 1987, *Oldham 7680 et al.* (DAO, MICH). **MANITOULIN DISTRICT**: Howland Twp., Manitoulin Island, 3.2 km N of Sheguiandah, about 5 clumps on E side of Hwy. 68, 11 Sep 1994, *Oldham 16730 et al.* (DAO). **MIDDLESEX CO.**: Delaware Twp., Hwy. 402, 1 km SE of Sharon, single large clump on grassed roadside, 17 Feb 1987, *Oldham 7043* (DAO); North Dorchester Twp., Hwy. 73, 1 km N of Harrietsville, single roadside clump, 2 Aug 1989, *Oldham 9919 & McLeod* (DAO, MICH, UWO). **NIAGARA REGIONAL MUNICIPALITY**: City of Niagara Falls, Q.E.W. Hwy. at Hwy. 47, 5.8 km SW of Chippawa, several clumps on roadside, 24 Apr 1988, *Oldham 8048 & Meyers* (DAO). **NORTHUMBERLAND CO.**: Percy Twp., Hwy. 45, 4.0 km SSW of Hastings Post Office, 20+ clumps on roadside, 25 May 1993, *Oldham 14706* (DAO). **OXFORD CO.**: Blandford-Blenheim Twp., Hwy. 401, 7.1 km ENE of Woodstock Post Office, a few roadside clumps, 8 Sep 1990, *Oldham 11817* (DAO, MICH, TRTE). **PETERBOROUGH CO.**: City of Peterborough, Hwy. 7, 100 m E of Airport Road, a few roadside clumps, 25 May 1994, *Oldham 16007* (DAO). **VICTORIA CO.**: Manvers Twp., Hwy. 7A, 1 km E of Pigeon River, 4 clumps on grassy highway edge, 14 Oct 1986, *Oldham 7031 & Delisle-Oldham* (DAO, MICH, TRTE).

Webber et al. (1985) first reported this grass in Ontario, on the basis of 1982 and 1983 collections from Kent, Elgin, and Essex Counties. Previous Canadian reports (Breitung 1957, Boivin 1981) are based on cultivated material. Specimens (and one sight record) are from sixteen counties scattered over a wide area of southern Ontario, to north of Sault Ste. Marie (Figure 1). Ontario records are all from roadsides, primarily larger highways, but also smaller roads. Abundance varies from a single clump in several instances, to several dozen clumps

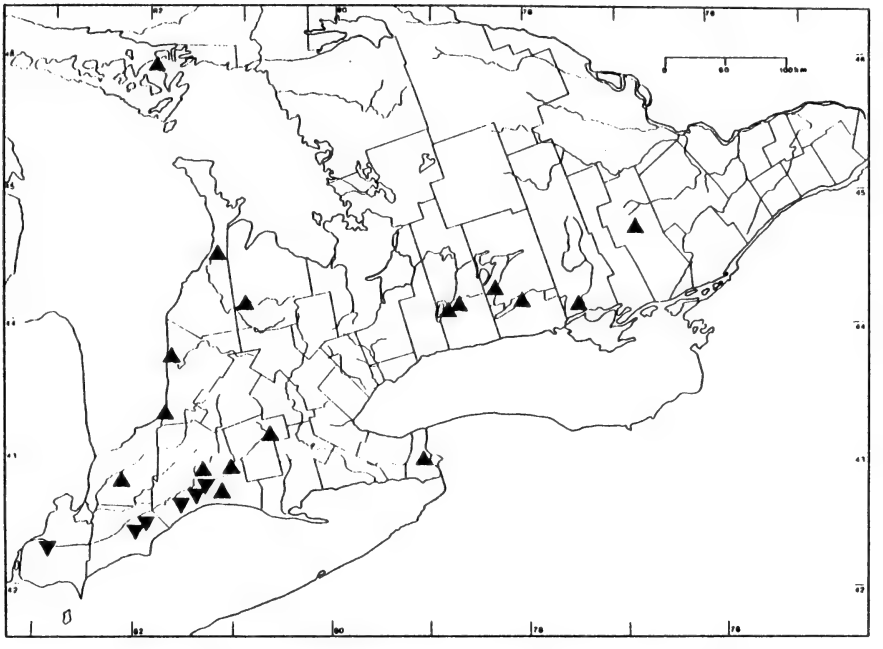

FIGURE 1. Distribution of *Agropyron elongatum* in southern Ontario (collection from Algoma District not mapped). Triangles (▲) represent specimens reported here, inverted triangles (▼) represent records from the literature (see text).

scattered over a kilometer or more. Once recognized, *Agropyron elongatum* can be identified from a rapidly moving vehicle at almost any time of year, which is how all of the reported populations were located. Its large, erect culms (2 m or more in height) persist in robust clumps well into the winter.

The species is well established and widespread, but of recent occurrence in Ontario. Although it is widely planted in western North America as a forage grass (Dewey 1983), it has not been included in any of the most recent floristic treatments for adjacent states and provinces, *i.e.* Michigan (Voss 1972), Ohio (Braun 1967), Pennsylvania (Rhoads & Klein 1993), New York (Mitchell 1986), Minnesota (Ownbey & Morley 1991), Manitoba (Scoggan 1978), Quebec (Scoggan 1978) or New England (Seymour 1982). Swink and Wilhelm (1994) reported the first Chicago region collection, from Cook County, Illinois, in 1974 from saline habitat along an expressway. A 1991 collection from Hants County, Nova Scotia (*McLeod 91146* at DAO), appears to be the first non-Ontario Canadian record outside of cultivation. Roland and Smith (1969) do not list the species for Nova Scotia, but state that "other species [of *Agropyron*] from western Canada have been planted on the running dykes and may possibly persist." Elsewhere in North America, it is known from the Great Plains

(McGregor & Barkley 1977, McGregor et al. 1986) and western states (Cronquist et al. 1977). Introduction to Ontario would seem to have been from western populations dispersed by highway activities.

Apart from the misapplication of the epithet *elongatum* to North American decaploid plants (Dewey 1983), nomenclatural controversy at the genus level has generated a number of synonyms for this taxon: *Elytrigia pontica* (Podp.) Holub, *Elymus elongatus* ssp. *ponticus* (Podp.) Melderis, *Lophopyrum ponticum* (Podp.) A. Löve, and *Thinopyrum ponticum* (Podp.) Barkworth & D.R. Dewey (Löve 1984).

* *Alopecurus geniculatus* L. (Water Foxtail)

ELGIN CO.: Dunwich Twp., 5.5 km SW of Dutton Post Office, Hwy. 401 eastbound service center, locally common in wet areas of lawn in picnic area, 21 May 1990, *Oldham 10812* (DAO, MICH, UWO); Southwold Twp., Hwy. 3, 7.1 km NE of Shedden Post Office, 22 May 1991, *Oldham 12546* (DAO, UWO). **ESSEX CO.**: Malden Twp., Amherstburg, rare lawn weed in urban neighbourhood, 13 May 1988, *Oldham 8077* (DAO); Maidstone Twp., 2.5 km NE of Essex Post Office, locally common in periodically wet open area near sewage lagoon, 18 May 1988, *Oldham 8098* (DAO, UWO); Pelee Twp., Pelee Island, rare and local in disturbed ground at edge of vineyard on W side of island, 18 Aug 1992, *Oldham 14181* (DAO). **HALDIMAND-NORFOLK REGIONAL MUNICIPALITY**: City of Nanticoke, 2.8 km NW of Nanticoke Post Office, locally abundant in moist roadside ditch, 21 May 1991, *Oldham 12525 & Allen* (DAO, TRTE). **KENT CO.**: Tilbury East Twp., 3.3 km NE of Tilbury Post Office, Hwy. 401 westbound service center, locally common in low wet areas of picnic area lawn, 18 May 1993, *Oldham 14630* (DAO). **LAMBTON CO.**: Walpole Island First Nation, Seaway Island, locally common in wet areas of open weedy wasteland over mercury dump site, 25 May 1985, *Oldham 4867 et al.* (DAO, MICH). **MIDDLESEX CO.**: City of London, South Thames River between Wellington and Adelaide Streets, local in standing water of low areas of urban park, 24 May 1983, *McLeod 8311* (DAO, UWO). **PEEL REGIONAL MUNICIPALITY**: City of Mississauga, Erindale College campus, ditch beside campus pub, 11 Jun 1973, *Laudenbach 16773* (TRTE). **PRESCOTT & RUSSELL UNITED COUNTIES**: 3 km E of Embrum, S side of road at sewage lagoons, uncommon, wet ditch in clay, 4 Jun 1988, *Brunton 7949* (CAN). **SIMCOE CO.**: City of Barrie, SE side of Essa Rd. (Hwy. 27), just SW of Veterans Drive, wet roadside ditch, abundant in a small zone, forming a dense, uniform stand in ditch bottom, 8 Jun 1995, *Reznicek 10026 & Reznicek* (BRCH, DAO, GH, MICH); Flos Twp., Hwy. 27, 4.1 km SE of Elmvale, common for several hundred meters in moist roadside ditch, 7 Jun 1995, *Oldham 17192 et al.* (DAO, MICH); West Gwillimbury Twp., about 2.5 km SW of mouth of Holland River, abandoned sod farm, 29 May 1982, *Webber 4213 & Petsche* (CAN, MICH, TRTE). **THUNDER BAY DISTRICT**: Hwy. 627, 350 m S of Hwy. 17, local in moist roadside ditch, 23 Jun 1995, *Oldham 17353* (DAO, LKHD, MICH); Lecours Twp., Hwy. 17, 7.5 km E of Black River bridge, uncommon in moist roadside ditch, 3 Aug 1995, *Oldham 17684 & Bakowsky* (DAO, LKHD). **YORK REGIONAL MUNICIPALITY**: Newmarket, floodplain of Holland River, common in wet meadow and riverbank, 30 May 1985, *Sharp 1391* (TRTE).

This European grass was reported in Ontario by Macoun (1888) from Amherstburg in Essex County and Presqu'ile Point in Northumberland County. Dore and McNeill (1980) reported only one other occurrence, on the basis of plants arising from a lawn-grass mixture in Ottawa, from where there are also more recent collections (DAO and MICH). Contrary to Dore and McNeill (1980), this species does seem to survive and persist, at least in the southern

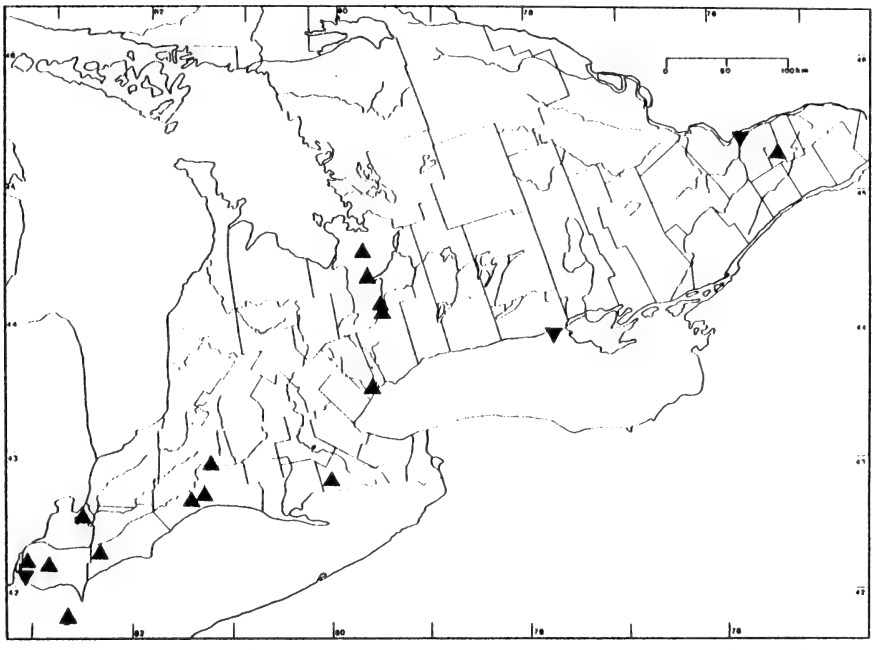

FIGURE 2. Distribution of *Alopecurus geniculatus* in southern Ontario (collections from Thunder Bay District not mapped). Triangles (▲) represent specimens reported here, inverted triangles (▼) represent records from the literature (see text).

part of the province. *Alopecurus geniculatus* also occurs as a weed in western and eastern Canada (Scoggan 1978).

Recent collections are reported from ten additional Ontario counties (Figure 2; Thunder Bay District records not mapped), indicating that this species is presently relatively widespread in southern Ontario. Collections have come mainly from low, moist lawns and roadside ditches where it has probably been introduced with grass seed. In southern Ontario, *Alopecurus geniculatus* is most conspicuous in May and early June. Garlitz (1989) recently reported a new station for this species in the northeastern Lower Peninsula of Michigan.

* *Apera interrupta* (L.) P. Beauv. (Interrupted Windgrass)

BRUCE CO.: Saugeen Twp., MacGregor Point Provincial Park, Huron Campground, very local on two sandy campsites, 18 Jun 1989, *Oldham 9397 & Delisle-Oldham* (DAO, MICH). **ELGIN CO.**: Aldborough Twp., 6.0 km SE of West Lorne, uncommon and local in open, dry, sandy cemetery, 6 May 1989, *Oldham 8984* (DAO); Malahide Twp., Aylmer Wildlife Management Area, 4.3 km NE of Aylmer, local in dry, open waste ground, 27 Jun 1991, *Oldham 12853* (DAO, MICH, UWO). **HALTON REGIONAL MUNICIPALITY**: Burloak Waterfront Park, sparse in open lawn and piles of sandy fill and rubble, 11 Jun 1984, *Feth 16267* (TRTE). **LAMBTON CO.**: Bosanquet Twp., Pinery Provincial Park, Burley Camp-

ground, scattered and uncommon on mesic, exposed sand of campsites, 7 Jun 1989, *Sutherland 8843* (DAO). **LANARK CO.**: North Burgess Twp., Murphy's Point Provincial Park, campsite #184, disturbed sand in mesic rocky mixed deciduous woodland, 21 Jun 1984, *Sutherland 4955 & Gartshore* (DAO, TRTE). **MANITOULIN DISTRICT**: Mills Twp., Obegewong Campground, S end of Lake Wolsey, locally common on sandy campsites, 7 Jul 1989, *Oldham 9598 & Delisle-Oldham* (DAO, MICH, TRTE, WAT). **PEEL REGIONAL MUNICIPALITY**: City of Mississauga, Credit River floodplain below Erindale College Campus, open, disturbed, recently sown lawn on former floodplain, 20 Jun 1985, *Crins 6772* (TRTE). **SIMCOE CO.**: City of Barrie, frequent but very local in weedy waste ground and weedy foundation plantings around shopping mall, 16 Jun 1983, *Reznicek 7148 & Reznicek* (DAO, MICH, TRTE).

McNeill (1981) first reported this Eurasian weed in Ontario, on the basis of a 1977 collection by J.F. Alex from a sod farm seeded with *Poa pratensis* near Burlington in Halton County. Collections from four of the nine localities cited came from campsites, three of them in provincial parks, and the fourth, a private campground. On campsites, *Apera interrupta* grows in open, well-drained soils, often on tent pads. Perhaps it has been dispersed by tents and other camping equipment, as was speculated for *Veronica verna* by Crins et al. (1987), or as a weed in commercial grass seed and sod. Keys in Grayum and Rohman (1986) and McNeill (1981) separate *Apera* from the similar genus *Agrostis*, and from the other adventive *Apera* species, *A. spica-venti* (L.) Beauv.

Long established in western North America (McNeill 1981), *Apera interrupta* now appears to be increasing in eastern North America, judging by earliest collections from Illinois in 1975 (Henry et al. 1978), Quebec in 1979 (Cayouette et al. 1983), Ohio in 1980 (Cusick & Brandenburg 1984), Wisconsin in 1981 (Solheim & Judziewicz 1984), Massachusetts in 1982 (Grayum & Rohman 1986), New York in 1983 (Cope 1992), and Indiana and Maine in 1992 (Swink & Wilhelm 1994, Oldham & Darbyshire 1993).

\+ *Aristida oligantha* Michaux (Prairie Three-awn)

ELGIN CO.: City of St. Thomas, locally abundant in cinders of railway yard, 27 Jul 1989, *Oldham 9863* (DAO, UWO); Southwold Twp., 0.6 km W of Shedden Post Office, locally abundant on dry open ground near railway tracks, 30 Aug 1989, *Oldham 10103* (DAO, MICH, TRTE, UWO, WAT). **ESSEX CO.**: City of Windsor, locally abundant at several locations along railways and in railway yards, 18 Sep 1982, *Oldham 3315* (DAO). **HAMILTON-WENTWORTH REGIONAL MUNICIPALITY**: City of Hamilton, CN railway yard, 1 km E of Greater Hamilton Shopping Center, locally abundant along railway tracks, 29 Sep 1995, *Oldham 18308* (DAO, HAM, MICH, TRTE). **KENT CO.**: Howard Twp., Ridgetown, locally common at edge of Conrail railway tracks, 2 Oct 1991, *Oldham 13504* (DAO, MICH). **LAMBTON CO.**: City of Sarnia, locally common along railway tracks in railway yard, 4 Aug 1991, *Oldham 13073* (DAO).

Catling et al. (1977) first reported this grass in Ontario on the basis of a 1976 collection from a railway yard in Fort Erie, Niagara Regional Municipality. In 1987, the species was found to be still thriving in the Fort Erie railway yards (*Oldham & Sutherland 7841* at DAO, BUF). The six collections cited add localities in five new counties. At all sites the species is associated with railway tracks and at four sites it occurs in railway yards.

Zika (1990) reported the species in New Hampshire and Vermont, and noted

its recent increase along railways in Vermont. *Aristida oligantha* is a widespread annual grass of dry open ground throughout much of the eastern United States (Hitchcock 1951). It is probably adventive in Ontario and the more northern states.

* ***Bromus* ×*pseudothominii* P.M. Smith emend H. Scholz** (Brome)

ESSEX CO.: City of Windsor, adjacent to Windsor Salt Factory, uncommon and local along weedy roadside, 14 Jul 1985, *Oldham 5182 & Delisle-Oldham* (DAO, det. P.M. Smith). **HALDIMAND-NORFOLK REGIONAL MUNICIPALITY**: Town of Simcoe, rare weed of disturbed shaded ground near railway tracks, 5 Aug 1989, *Oldham 9962* (DAO). **HAMILTON-WENTWORTH REGIONAL MUNICIPALITY**: Hamilton, Royal Botanical Gardens, 13 Jun 1957, *Tamsalu 515* (DAO, sub. *B. mollis*). **KENT CO.**: Harwich Twp., Rondeau Provincial Park, rare and local in sandy-gravelly parking area, 6 Jun 1994, *Oldham 16065* (DAO). **LAMBTON CO.**: Bosanquet Twp., Pinery Provincial Park, local on sandy roadside in Burley Campground, 12 Jun 1989, *Oldham 9308* (DAO, MICH, TRTE). **LANARK CO.**: North Burgess Twp., Murphy's Point Provincial Park, scarce on gravel roadside, 3 Jun 1986, *Darbyshire 2962 et al.* (DAO, det. P.M. Smith). **MIDDLESEX CO.**: City of London, Watson Street Dump, edge of open landfill site (now used as a snow dump) in Thames River floodplain, 8 Jun 1982, *McLeod 8220* (DAO, UWO). **NIAGARA REGIONAL MUNICIPALITY**: Queenston, rare weed in open ground near Niagara River, 10 Jun 1988, *Oldham 8181 et al.* (DAO); Pelham Twp., Hwy. 20, 4 km W of Fonthill, local on roadside, 21 Jun 1986, *Oldham & Delisle-Oldham 6379* (DAO).

This taxon was described as a fertile hybrid derived from *Bromus hordeaceus* L. and *B. lepidus* Holmberg (Smith 1968), but is considered a subspecies of *B. hordeaceus* by some authors (Scholz 1970, Pavlick 1995). Although *B. hordeaceus* (=*B. mollis* L.) has been reported as a weed throughout much of the United States and parts of Canada (Pavlick 1995), including Ontario (Dore & McNeill 1980), there are no Canadian reports of *B. lepidus*. *Bromus* ×*pseudothominii* was reported for Ontario in the checklist of Morton and Venn (1990). Pavlick (1995), who considers the taxon as *B. hordeaceus* subsp. *pseudothominii* (P. Smith) H. Scholz, reports it as sporadic throughout the North American range of *B. hordeaceus*. Apparently quite common in Europe, particularly in ruderal areas (Tutin et al. 1979), the hybrid resembles and is frequently confused with *B. hordeaceus*. The lemmas, however, are usually glabrous and have a wider, more distinctly angled margin and the mature grain is usually as long as the palea. The key by Smith (1968) will distinguish between the hybrid and its parents.

* *Bromus squarrosus* L. (Chess)

BRANT CO.: City of Brantford, 5.2 km NW of Brantford Post Office along Erie & Northern (C.P.) railway, single dense colony along railway tracks, 16 Jun 1990, *Oldham 11098* (DAO, MICH, TRTE). **ELGIN CO.**: City of St. Thomas, rare and local in disturbed weedy ground of railway yard, 27 Jul 1989, *Oldham 9856* (DAO). **ESSEX CO.**: Mersea Twp., Point Pelee National Park, open, disturbed, sandy area south of maintenance compound, locally common, 12 Jul 1985, *Oldham 5168* (DAO (det. P.M. Smith), MICH, TRTE). **GREY CO.**: Keppel Twp., North Keppel, dry open waste ground by shore, near houses, 28 Jul 1978, *Johnson 5* (CAN). **HALDIMAND-NORFOLK REGIONAL MUNICIPALITY**: Town of Haldimand, Hagersville, local in dry, open, disturbed ground adjacent to flooded quarry, 26 Jul 1991, *Oldham 12987* (DAO). **HASTINGS CO.**: Tyendinaga Twp., Salmon

River Alvar, ca. 2 km SSW of bridge at Lonsdale, uncommon in open alvar along trail, 24 Jul 1995, *Oldham 17591 et al.* (DAO). **MIDDLESEX CO.**: City of London, local in weedy, vacant, urban lot, 30 Jun 1989, *Oldham 9532 & Delisle-Oldham* (DAO, UWO).

Webber et al. (1985) first reported *Bromus squarrosus* in Ontario on the basis of collections from Erieau in Kent County. Our collections add seven new counties and indicate that the species is spreading in the province, often along railway tracks, as has been reported for adjacent Michigan (Voss 1972). *Bromus squarrosus* resembles *B. japonicus*, with which it sometimes grows, but can be distinguished from the latter by its wider lemmas (2.5-3.2 mm vs. less than 2.2 mm) and more widely spreading, sometimes recurved awns. *Bromus squarrosus* is a rare introduction in Pennsylvania (Rhoads & Klein 1993) and New York (Mitchell 1986, New York Flora Association 1990), but is unreported from Ohio (Braun 1967), Minnesota (Ownbey & Morley 1991), and New England (Seymour 1982).

***Diarrhena obovata* (Gleason) Brandenburg** (Beak Grass)

LAMBTON CO.: Bosanquet Twp., Ausable River Valley, 3.3 km NNE of Arkona Post Office, rare and local in rich floodplain woods, 15 Aug 1990, *Oldham 11640* (DAO); Brooke Twp., Sydenham River Corridor Carolinian Canada site, 6.1 km S of Alvinston Post office, single colony, 19 Jun 1992, *Bowles JB/SYD/92.097* (DAO, MICH, UWO). **MIDDLESEX CO.**: City of London, Kilworth, near Thames River, 20 Jun 1994, *Draper D601* (UWO); West Williams Twp., Ausable River Valley, 3 km NE of Arkona Post Office, 5 Sep 1988, *Tiedje 5186* (DAO, MICH, UWO).

At the northern part of its range in southern Michigan and northern Ohio, this genus has not been reported from Ontario (Brandenburg et al. 1991). Although this taxon is referred by most authors to *Diarrhena americana* Beauv. or *D. americana* var. *obovata* Gleason, Brandenburg et al. (1991) have recognized two species in North America. The more northwesterly *D. obovata* has a swollen and beaked grain and will key with *Catabrosa* to couplet 69 in the key to genera by Dore and McNeill (1980, p. 25).

Highly localized, *Diarrhena obovata* occurs as scattered robust clumps for several hundred meters along both sides of the Ausable River valley near Arkona. The relatively undisturbed floodplain woods on heavy soils are dominated by White Ash (*Fraxinus americana* L.), American Basswood (*Tilia americana* L.) and Black Walnut (*Juglans nigra* L.). Associated species include *Bromus pubescens* Muhlenb. ex Willd., *Erigeron strigosus* Muhlenb. ex Willd., *Solidago canadensis* L., *Eupatorium rugosum* Houtt., *Elymus canadensis* L., and *Impatiens pallida* Nutt. At the Sydenham River site only a single stand of *Diarrhena* was observed, growing in silty loam soil near the base of a mesic valley slope Black Walnut savannah at the edge of floodplain woods.

\+ *Diplachne acuminata* Nash (Sprangletop or Salt Meadow Grass)

ELGIN CO.: City of St. Thomas, low moist ground in cinders near tracks in railway yard, 27 Jul 1989, *Oldham 9865* (DAO, MICH, UWO); Dunwich Twp., 4.7 km WNW of Dutton, rare, 20-30 plants in open saline ditch of Hwy. 401 service center, 26 Sep 1988, *Oldham 8828* (DAO, MICH, UWO); Southwold Twp., Hwy. 401, 3.3 km E of Iona Road bridge, sev-

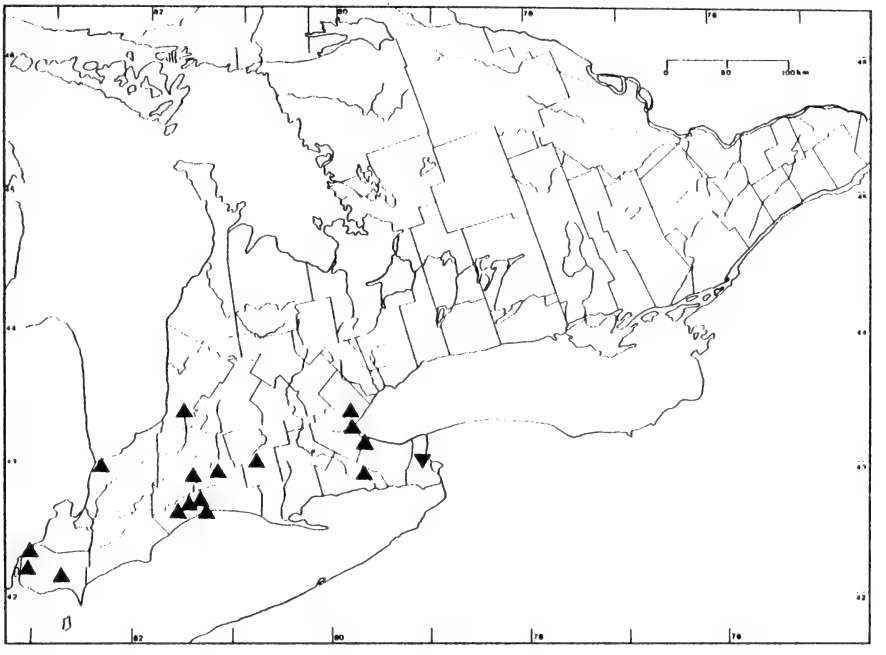

FIGURE 3. Distribution of *Diplachne acuminata* in Ontario. Triangles (▲) represent specimens reported here, inverted triangles (▼) represent records from the literature (see text).

eral patches in center median, 29 Aug 1988, *Oldham 8544* (DAO, UWO); Yarmouth Twp., Port Stanley, locally common in disturbed, moist, saline ground near oil storage tanks near harbour, 16 Sep 1990, *Oldham 11897* (DAO, MICH, UWO). **ESSEX CO.**: Anderdon Twp., just S of Canard River mouth, W side of Hwy. 18, rare weed in gravel parking lot, 16 Sep 1986, *Oldham 6953* (DAO, MICH); City of Windsor, railway yard just W of Dougall Street, locally common, 2 Oct 1982, *Oldham 3406* (DAO); Gosfield South Twp., 4.7 km NW of Ruthven Post Office, single plant in gravel driveway, 26 Sep 1986, *Oldham 6984* (DAO). **HALDIMAND-NORFOLK REGIONAL MUNICIPALITY**: SW of Canborough, junction of Hwy. 3 and Regional Road 14, locally common in moist weedy ground, 4 Sep 1990, *Cusick 29191* (DAO, OS). **HALTON REGIONAL MUNICIPALITY**: City of Burlington, Burlington West Railway Station, local in moist disturbed area near railway tracks, 6 Oct 1991, *Oldham 13523* (DAO, TRTE). **HAMILTON-WENTWORTH REGIONAL MUNICIPALITY**: City of Hamilton, Sherman Street Industrial Complex, Stelco Steel, edge of parking area, 29 Sep 1995, *Oldham 18281* (DAO, HAM, TRT); Town of Stoney Creek, QEW Highway, just west of Niagara R.M. border, near Winona, local on roadside, 14 Sep 1995, *Oldham 18218* (DAO, HAM). **HURON CO.**: Hay Twp., C.N. railway tracks in Hensall, local in low, wet area near tracks, 22 Oct 1991, *Oldham 13567* (DAO, MICH). **LAMBTON CO.**: City of Sarnia, local in moist disturbed ground near tracks in railway yard, 4 Aug 1991, *Oldham 13075* (DAO, UWO). **MIDDLESEX CO.**: City of London, Hwy. 401 at Wellington Road intersection, several robust clumps in saline median, 17 Sep 1992, *Oldham 14423 & Bowles* (DAO); North Dorchester Twp., Hwy. 401, 0.5 to 2 km W of Dorchester Road, locally abundant for several kilometers in saline center median, 14 Oct 1986, *Oldham 7033 & Delisle-Oldham* (DAO, MICH, UWO). **OXFORD CO.**: Hwy. 401 at

Hwy. 403, 5.4 km E of Woodstock Post Office, locally common in Hwy. 401 center median, 8 Sep 1990, *Oldham 11816* (DAO, MICH).

Dore and McNeill (1980) include this species on the basis of the report and specimens of Catling et al. (1977) from a Niagara Falls railway yard. We document occurrences in nine additional southwestern counties, almost always in saline areas of railway yards and moist highway ditches (Figure 3). *Diplachne acuminata* appears to be spreading in inland areas of eastern North America, on the basis of first collections from Michigan in 1966 (Stephenson 1967), Massachusetts in 1979 (Zika 1990), Vermont in 1981 (Zika 1990), Pennsylvania in 1984 (Cusick 1988), and West Virginia in 1985 (Cusick 1988). Tucker (1994) documented its recent rapid spread in New York state.

Most North American authors do not follow McNeill (1979) in distinguishing the genus *Diplachne* from *Leptochloa*. In addition, some authors do not distinguish *L. acuminata* (Nash) Mohlenbrock from *L. fascicularis* (Lam.) A. Gray or recognize it only as *L. fascicularis* var. *acuminata* (Nash) Gleason.

* ***Elymus arenarius* L.** (Lyme Grass)

BRUCE CO.: Huron Twp., just S of Point Clark at N part of Amberly Beach, sand dunes in untreed area, 29 Jun 1985, *Darbyshire 2667 & Aiken* (CAN, DAO); Huron Twp., Bruce Beach, 6.2 km SSW of Kincardine Post Office, on Lake Huron shore, rare and local on sandy beach, 15 Jul 1987, *Oldham 7643* (DAO); Huron Twp., Point Clark on Lake Huron, locally common on sand beach, 17 Jun 1989, *Oldham 9363 & Delisle-Oldham* (DAO); Huron Twp., Lurgan Beach on Lake Huron, sand dunes near beach, 17 Jun 1989, *Oldham 9366 & Delisle-Oldham* (DAO). **HURON CO.**: Ashfield Twp., Amberly Beach on Lake Huron, locally common on sand beach, 28 Jul 1995, *Oldham 17645 et al.* (DAO). **MIDDLESEX CO.**: London Twp., C.P.R. tracks, 1 km S of Hyde Park, single large clone along railway tracks, 9 Jul 1987, *McLeod 8798 et al.* (MICH, UWO).

This European grass is occasionally planted as a sand binder (Voss 1972) or ornamental, but Dore and McNeill (1980) state that no such plantings are known in Ontario. Elsewhere in Canada, Scoggan (1978) reports it from British Columbia and Newfoundland. Recent records near cottage communities along the Lake Huron shore in Bruce and Huron Counties may have spread from local plantings. The species is well established in that area, growing on natural sand dunes with native species such as *Ammophila breviligulata* Fernald, *Panicum virgatum* L., and *Agropyron psammophilum* J.M. Gillett & H.A. Senn. The Middlesex County colony is adventive along a railway.

Elymus arenarius is superficially very similar to the native *E. mollis*, from which it can be distinguished in having culms glabrous at the summit (those of *E. mollis* are finely and densely pubescent). Some authors (*e.g.* Gleason & Cronquist 1991) refer this taxon to *Leymus arenarius* (L.) Hochst.

***Eragrostis capillaris* (L.) Nees** (Lace Grass)

LAMBTON CO.: Walpole Island First Nation, rare and local from sandy ground near sand pits at north end of Walpole Island, 31 Aug 1985, *Oldham 5705* (DAO).

Eragrostis capillaris is considered native in southeastern Michigan (Voss 1972), the Chicago region (Swink & Wilhelm 1994), northern Ohio (Braun 1967), northern Illinois (Mohlenbrock 1973), and Wisconsin (Fassett 1951), but has not been previously reported from Ontario or Canada (Scoggan 1978). Collected in 1985 from dry, sandy ground near the north end of Walpole Island in an area rich with rare native plants, subsequent searches have failed to detect the species. It is either extremely local and has been overlooked, or the 1985 collection came from a short-lived (and perhaps adventive) colony. *Eragrostis capillaris* has been listed as a rare native Canadian plant by Argus and Pryer (1990), on the basis of the above record.

This species is fairly distinctive, with its small spikelets on elongate capillary pedicels. Superficially it resembles certain *Panicum* species. The presence of 2-5-flowered spikelets, however, will immediately distinguish it from the single-flowered *Panicum* species.

Zika (1990) reports that, although *Eragrostis capillaris* is native on calcareous ledges in Vermont, it is expanding as an adventive species along railway tracks. Swink and Wilhelm (1994) found it somewhat weedy in the Chicago region, but also reported it from open woodland.

+ ***Eriochloa contracta*** **Hitchc.** (Prairie Cupgrass)

ESSEX CO.: Rochester Twp., 5.5 km E of Belle River, several hundred plants scattered along roadside for about 30 m, 10 Sep 1991, *Oldham 13441* (DAO, MICH, TRTE).

Shaw and Webster (1987) do not report any member of the genus from Canada or any of the neighbouring states, with the closest localities being in Indiana, Illinois, and Virginia. The species is a widespread weed in fields and ditches of the midwestern United States, and is adventive eastward (Crins 1991). It was first collected in the Chicago region in 1990 as a roadside weed and is now known from seven counties (Swink & Wilhelm 1994).

Eriochloa is one of the panicoid grasses, characterized by one fertile floret per spikelet and with the lemma and palea somewhat indurate at maturity. It differs from all other panicoid grasses in Ontario in the presence of a hairy terminal awn on the fertile lemma. It will run to couplet 19 with *Panicum* in the key to genera by Dore and McNeill (1980, p. 21).

* ***Festuca gigantea*** **(L.) Villars** (Giant Fescue)

WELLINGTON CO.: Elora, glen of Irvine River just above its junction with the Grand River, moist rich soil among rocks (limestone) at base of ravine a few feet above water, 26 Sep 1992, *Cody 35573* (DAO).

This Eurasian grass has not previously been reported from Ontario (Dore & McNeill 1980), although two sites have been reported in Quebec (Dubé 1983). Its occasional cultivation as an ornamental plant has led to its escape and establishment at a few scattered localities in eastern North America. The open leaf sheaths, glabrous ovary, falcate auricles, and lemma awns (longer than the

lemma body) distinguish this species from similar species of *Bromus* and other *Festuca* species.

Glyceria melicaria (Michaux) Hubb. (Long Manna Grass)

MIDDLESEX CO.: North Dorchester Twp., Dorchester Swamp, two large populations about 1.2 km apart in wet soil of openings along stream in hardwood-conifer swamp, hundreds of fruiting culms, 9 Jul 1985, *McLeod 856* (DAO, TRTE).

Dore and McNeill (1980) map this grass only in central and eastern Ontario. A specimen (*Hume & Day s.n.* (UWO) in 1971) reported from Haldimand-Norfolk (Sutherland 1987) is vegetative, and probably belongs to another member of the genus. The Dorchester Swamp record is more than 300 kilometers from the nearest locality mapped by Dore and McNeill (1980) in Muskoka District, but less than 100 kilometers from northern Pennsylvania where the species is widespread (Rhoads & Klein 1993). A record in Dodge (1915), "reported by Prof. Macoun as noticed in woods near Sarnia; apparently rare", was rejected by Dore and McNeill (1980), but now seems more plausible.

+ ***Muhlenbergia asperifolia* (Nees & Meyen ex Trin.) Parodi** (Scratch Grass)

ALGOMA DISTRICT: Garden Lake Indian Reservation 14, Hwy. 17 at Point Charles Road, 100 m E of Root River bridge, single clone on north roadside, 2 Aug 1995, *Oldham 17660 & Bakowsky* (DAO). **BRANT CO.**: South Dumfries Twp., Paris, local in low moist former gravel pit near railway tracks, 10 Sep 1989, *Oldham 10164* (DAO, MICH). **ELGIN CO.**: Aldborough Twp., Hwy. 401, just E of Hwy. 76, single colony about 1.5 m in diameter in center median, 28 Sep 1987, *Oldham 7994* (DAO, MICH, TRTE, UWO); Southwold Twp., rare and local at edge of railway tracks, 24 Jul 1988, *Oldham 8386* (DAO, MICH, UWO); Yarmouth Twp., St. Thomas, railway tracks E of arena, single small patch in railway cinders, 4 Jun 1992, *Oldham 13777* (DAO). **ESSEX CO.**: City of Windsor, 29 Jul 1979, *Botham 2181* (CAN); Malden Twp., Big Creek, Holiday Beach Provincial Park, local in gravel parking lot, 14 Oct 1984, *Oldham 4648* (TRTE); Sandwich West Twp., County Road 8, 1 km E of River Canard, single extensive roadside colony, 29 Aug 1985, *Oldham 5671* (DAO); Maidstone Tw.p, County Road 25, 1 km S of County Road 42, single patch on roadside, 22 Sep 1985, *Oldham 5575 & Sutherland* (DAO); Tilbury North Twp., 5.7 km NNW of Tilbury Post Office, local in disturbed sandpit, 22 Sep 1985, *Oldham 5580 & Sutherland* (DAO). **HALTON REGIONAL MUNICIPALITY**: City of Burlington, Burlington West Railway Station, local in moist open disturbed ground near railway tracks, 6 Oct 1991, *Oldham 13522* (DAO, TRTE). **HAMILTON-WENTWORTH REGIONAL MUNICIPALITY**: City of Hamilton, railway tracks between Ottawa Street North and Kenilworth Avenue North, along railway tracks, 29 Sep 1995, *Oldham 18293* (DAO, HAM). **KENT CO.**: Orford Twp., Hwy. 401, 3.8 km W of Elgin County border, single patch in center median, 1 Oct 1987, *Oldham 8001* (DAO, MICH, TRTE, UWO). **LAMBTON CO.**: City of Sarnia, railway yard at S end of city, locally abundant in saline area at edge of tracks, 29 Jul 1983, *Oldham 4014 & Jellicoe* (DAO, MICH, TRTE); Warwick Twp., Canadian Pacific railway, 5.6 km E of Watford Post Office, locally common in moist ditch beside railway, 4 Aug 1991, *Oldham 13060* (DAO). **MIDDLESEX CO.**: City of London, Canadian National railway S of Wilton Grove Road, few plants in gravelly soil near railway siding switch, 9 Oct 1981, *McLeod 81241* (DAO, UWO). **OXFORD CO.**: Town of Tillsonburg, Canadian National and Canadian Pacific railway yard, uncommon and local near tracks, 30 Jul 1989, *Oldham 9901* (DAO, MICH); City of Woodstock, Hwy. 401, 0.5 km E of Hwy. 59, single patch on road shoulder, 29 Sep 1989, *Oldham 10387 & McLeod* (DAO, MICH). **PERTH CO.**: City of Stratford, rare and local in disturbed areas near tracks in railway yard, 24 Jul 1988, *Oldham 8467* (DAO, MICH, WAT). **RAINY RIVER DISTRICT**: Fort Francis Town Municipality,

Fort Francis railway yard, rare in railway ballast, 6 Aug 1995, *Oldham 17892 & Bakowsky* (DAO); Sturgeon Falls Indian Reservation 23, Hwy. 11, 0.9 km W of Seine River bridge, single patch on gravel roadside, 6 Aug 1995, *Oldham 17864 & Bakowsky* (DAO). **THUNDER BAY DISTRICT**: Dawson Road Lots, Hwy. 11/17, ca. 8 km E of Shabaqua Corners, ca. 200 m long patch on roadside, 9 Aug 1995, *Oldham 18012 & Bakowsky* (DAO, LKHD). **YORK REGIONAL MUNICIPALITY**: Vaughan Twp., railway yard 4.5 km S of Maple, rare and local near tracks, 28 Aug 1992, *Oldham 14293* (DAO, MICH).

Catling et al. (1977) first reported *Muhlenbergia asperifolia* in Ontario, on the basis of a 1975 collection from Windsor and a 1976 collection from Niagara Falls. The species is still well established at both these locations and is spreading along roads and railways in southwestern and northwestern Ontario. Our collections add thirteen new Ontario counties (Figure 4; northern Ontario records not mapped). *Muhlenbergia asperifolia* is usually found in saline sites, such as ditches. Catling and McKay (1981) consider the species to be an obligate halophyte in the Great Lakes area. It appears to spread aggressively where it occurs, and we expect its Ontario range will continue to expand. Reznicek (1980) reported the species new to Michigan, and mapped its North American distribution. Although widespread in western Canada (Scoggan 1978), *M. asperifolia* is still local in the east.

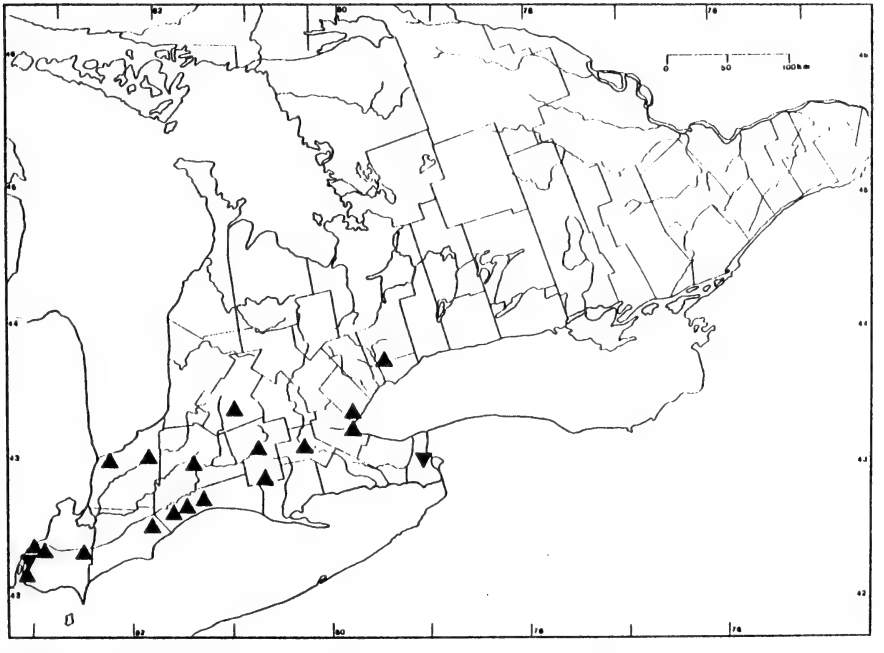

FIGURE 4. Distribution of *Muhlenbergia asperifolia* in southern Ontario (collections from Algoma, Rainy River, and Thunder Bay Districts not mapped). Triangles (▲) represent specimens reported here, inverted triangles (▼) represent records from the literature (see text).

***Muhlenbergia* ×*curtisetosa* (Scribner) Pohl** (Muhly)

ELGIN: Malahide Twp., Town of Aylmer, C.N.R. tracks W of Hwy. 73, open ground next to Co-op grain driers, 10 Sep 1986, *McLeod 86185* (DAO, MICH).

This poorly understood taxon represents a series of isolated hybrids between *Muhlenbergia schreberi* and various rhizomatous *Muhlenbergia* species (Pohl 1969). The hybrids generally have infertile pollen, small glumes (like *M. schreberi*), and a short rhizome. At the Ontario site *M. frondosa*, *M. mexicana*, and *M. schreberi* are all common. The Ontario specimen has probably infertile pollen but is producing well-formed seeds. *Muhlenbergia* ×*curtisetosa* has been previously reported from Illinois, Iowa, Missouri, Arkansas, Indiana, and Pennsylvania (Pohl 1969), but not from Canada (Scoggan 1978).

***Muhlenbergia sobolifera* (Muhlenb.) Trin.** (Muhly)

ESSEX: Pelee Twp., Pelee Island, Stone Road Alvar, rare and local in dry, rocky, limestone woodland, 21 Aug 1992, *Oldham 14212* (DAO, MICH).

Dodge (1914) reported this grass from the Ohio shore of Lake Erie, opposite Pelee Island, and Dore and McNeill (1980) speculated on its eventual discovery in Ontario. *Muhlenbergia sobolifera* is widespread in the eastern and central United States, south of the Great Lakes (Pohl 1969), but has not previously been reported from Canada (Scoggan 1978). Pohl (1969) indicates that the species grows in dry upland forests of oak or mixed hardwoods, on sandstone, chert, or limestone. At the Stone Road Alvar, *M. sobolifera* is rare and local in a dry oak (*Quercus* spp.) and Hackberry (*Celtis occidentalis* L.) woods on shallow soil over limestone bedrock. The site contains distinctive and unusual vegetation communities (Belcher et al. 1992), and an abundance of rare plant species, including several not known elsewhere in Canada (Duncan 1973, Oldham 1983 & 1988).

Among Ontario species of *Muhlenbergia*, *M. sobolifera* is most similar to *M. tenuiflora*, from which it differs by having glabrous internodes and sheaths, awnless or very short-awned florets, and anthers 0.5 to 0.8 mm long. The presence of rhizomes distinguishes *M. sobolifera* from the superficially similar *M. schreberi*.

Muhlenbergia uniflora (Muhlenb.) Fern. (Muhly)

PERTH CO.: Ellice Twp., Ellice Swamp, locally common along moist edges of snowmobile trail through extensive heath bog, 17 Jul 1990, *Oldham 11397* (DAO, MICH, TRTE).

This small grass is widespread but uncommon in Ontario. Dore and McNeill (1980) state that it is known from "almost 30" localities in Ontario, but map it no farther south than Muskoka District in the southern Georgian Bay area. Riley (1989) indicates that it is known slightly farther south, from a single site in Simcoe County (Matchedash Lake, *Reznicek 3877* at MICH). The Perth County collection is about 200 km southwest of the Simcoe County site. In Michigan, Voss

(1972) maps no records for the southern half of the Lower Peninsula. However there is a recent collection from Midland County (*Reznicek 7827* et al. at MICH) in the central Lower Peninsula, about 200 km west of Perth County, Ontario.

Panicum gattingeri Nash (Gattinger's Panic Grass)

ELGIN CO.: Dunwich Twp., just W of John E. Pearce Provincial Park entrance, gravelly roadside with numerous weedy species, 27 Aug 1982, *Webber 4837a & Kaiser* (TRTE); South Dorchester Twp., 4.2 km NNW of Springfield Post Office, locally common in sandy, grassy edge of dirt road, 5 Sep 1990, *Oldham 11793* (DAO, MICH, TRTE); Yarmouth Twp., 5.3 km NW of Aylmer Post Office, sandy roadside, 16 Sep 1990, *M.J. Oldham 11889* (DAO, UWO). **ESSEX CO.**: Pelee Twp., Pelee Island, Stone Road Alvar, 22 Aug 1986, *Oldham 6722* (DAO). **HALDIMAND-NORFOLK REGIONAL MUNICIPALITY**: Haldimand Twp., Holmes Creek, S of Cayuga, scattered over a small area of exposed soil along the edge of an old field, bordering the creek, 21 Aug 1985, *Sutherland 6448 et al.* (TRTE). **HURON CO.**: West Wawanosh Twp., Saratoga Swamp, uncommon on grassy roadside, 22 Sep 1988, *Oldham 8797 et al.* (DAO). **KENT CO.**: City of Chatham, uncommon at edge of Thames River, 25 Oct 1987, *Oldham 8023 & Delisle-Oldham* (DAO, MICH, TRTE, UWO). **MIDDLESEX CO.**: Biddulph Twp., Lucan, single clump in sidewalk crack, 21 Sep 1985, *Oldham 5569 et al.* (DAO, MICH); City of London, Exeter Road, locally common at edge of parking lot, 14 Sept 1987, *Oldham 7905* (DAO, MICH, TRTE, UWO); West Williams Twp., Ausable River at Hungry Hollow, single robust plant amongst rocks on floodplain, 5 Oct 1987, *Oldham 8003 et al.* (DAO, MICH, TRTE); East Williams Twp., 8.5 km SSE of Parkhill Post Office, abundant on roadside through woods, 19 Sep 1989, *Oldham 10296 & McLeod* (DAO, MICH, UWO); Mosa Twp., Big Bend Conservation Area, rare at edge of Thames River and uncommon on nearby roadside, 19 Sep 1989, *Oldham 10323 & McLeod* (DAO, MICH, TRTE, UWO, WAT); Lobo Twp., 2 km N of Komoka Post Office, rare on moist streambank of Oxbow Creek, 3 Oct 1989, *Oldham 10400 & McLeod* (DAO); North Dorchester Twp., 9.25 km NNW of Springfield Post Office, uncommon on roadside, 8 Sep 1990, *Oldham 11815* (DAO); Delaware Twp., Komoka Provincial Park, gravelly shore of S side of Thames River, 7 Sep 1988, *McLeod 88256* (DAO, UWO); London Twp., Fanshawe Conservation Area, reservoir edge, 21 Sep 1991, *Oldham 13459* (DAO); West Nissouri Twp., 1.9 km S of Thorndale Post Office, along gravel roadside through abandoned gravel pit, 31 Aug 1993, *Oldham 15564* (DAO). **OXFORD CO.**: Zorra Twp., 4.4 km NW of Ingersoll Post Office, rare and local at edge of corn field, 8 Sep 1989, *Oldham 10152 & McLeod* (DAO, MICH); Southwest Oxford Twp., 9.0 km W of Tillsonburg Post Office, edge of artificial pond, 3 Sep 1990, *Oldham 11789* (DAO, MICH, UWO). **PERTH CO.**: Downie Twp., 10.4 km NE of St. Marys Post Office, locally common on roadside, 1 Sep 1993, *Oldham 15576 et al.* (DAO). **PRESCOTT & RUSSELL UNITED COUNTIES**: North Plantagenet Twp., Jessup's Falls Conservation Area on South Nation River, locally common on rock shore protection work and waste ground along river, 22 Aug 1989, *Oldham 10061* (CAN, DAO, MICH, TRTE, WAT).

Dore and McNeill (1980) map only a single Ontario specimen of *Panicum gattingeri*, on the basis of a 1951 collection from Middlesex County. Reznicek (1984a) maps two additional recent records, one in extreme eastern Ontario along the Ottawa River, the other in Halton County. Darbyshire (1987) reported it from the Ottawa-Carleton region, and Reznicek and Catling (1989) reported it from Long Point, Haldimand-Norfolk Regional Municipality. We have found the species to be quite widespread in southern Ontario, and can add six new counties (Figure 5). Undoubtedly *P. gattingeri* has been overlooked due to its similarity to *P. capillare*, *P. tuckermanii*, *P. philadelphicum*, and *P. flexile*.

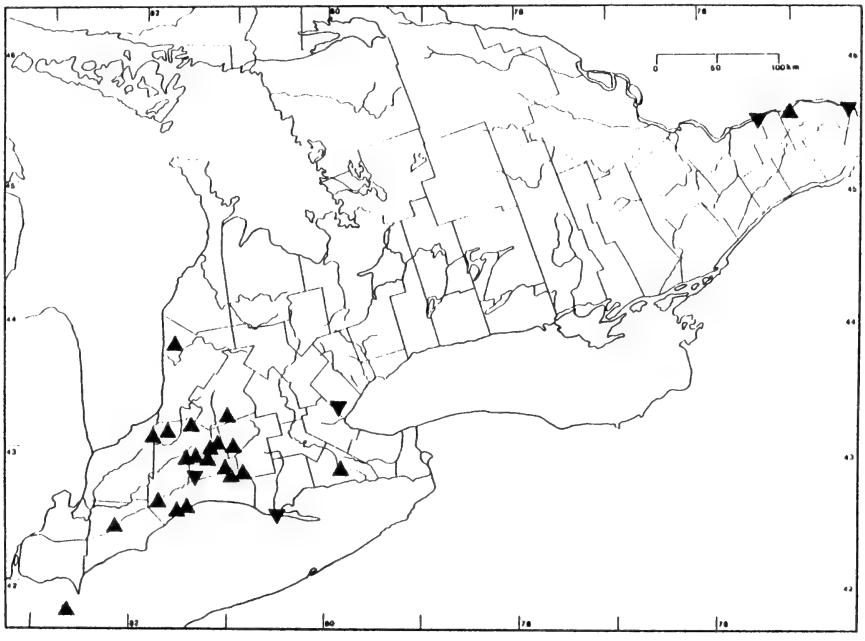

FIGURE 5. Distribution of *Panicum gattingeri* in Ontario. Triangles (▲) represent specimens reported here, inverted triangles (▼) represent records from the literature (see text).

Despite their similarity and frequent co-occurrence, these five grasses can be separated readily in the field on the basis of growth habit and spikelet size. The frequently branching and often prostrate stems and large spikelets help to separate *P. gattingeri* from other species. Darbyshire and Cayouette (1995) discuss the identification of *P. gattingeri* and other members of the *P. capillare* complex.

In Ontario, *Panicum gattingeri* appears to be native on floodplains, but it is also weedy along roadsides and edges of agricultural fields. In southwestern Ontario it is frequently associated with the common weedy grasses *P. capillare* and *P. dichotomiflorum*.

Panicum rigidulum Bosc ex Nees (Panic Grass)

ELGIN CO.: Dunwich Twp., 7.5 km NE of West Lorne, local in moist prairie area at Dutton Swamp, 10 Aug 1986, *Oldham 6692* (DAO); Aldborough Twp., 3.1 km SW of West Lorne, rare and local in overgrown, moist sandy area in meadow between railway tracks, 12 Sep 1990, *Oldham 11881* (DAO). **HALDIMAND-NORFOLK REGIONAL MUNICIPALITY**: City of Nanticoke, Waterford Ponds, locally common in thickets in open wet White Cedar meadows, 5 Aug 1986, *Sutherland 7575* (DAO, TRTE). **LAMBTON CO.**: Plympton Twp., Wyoming, locally common in ditch near Canadian National railway line, 4 Aug 1991, *Oldham 13066* (DAO, MICH). **MIDDLESEX CO.**: East Williams Twp., 2.9 km

ESE of Parkhill Post Office along southern boundary of Parkhill Conservation Area, rare and local in moist meadow near abandoned Canadian National railway, 15 Aug 1990, *Oldham 11658* (DAO, MICH, UWO).

Panicum rigidulum is a rare native grass in Ontario, mapped from only six sites in central Ontario by Reznicek (1984b). Our records add seven sites in four southwestern Ontario counties. Dore and McNeill (1980) reject a 1937 specimen from "wet meadows and shores" at Guelph in Wellington County, a record which now seems much more plausible in light of other southwestern Ontario collections. Although several collections were made near railways, the habitat and associates at each site suggest that all are native populations.

Panicum tuckermanii Fern. (Panic Grass)

ESSEX CO.: Mersea Twp., Point Pelee National Park, East Beach, uncommon and local on moist sand, 4 Sep 1988, *Oldham 8675 et al.* (DAO, TRTE, UWO); Malden Twp., *ca.* 4 miles SE of Amherstburg, beach of Lake Erie at mouth of Big Creek, open, wet, sandy strand, two large plants seen, much less abundant than *P. capillare* or *P. dichotomiflorum*, 24 Sep 1984, *Reznicek 7504 et al.* (MICH). **HALDIMAND-NORFOLK REGIONAL MUNICIPALITY**: Norfolk Twp., Long Point, W end of Hasting's Drive, rare and local on sand at marsh edge, 18 Sep 1987, *Oldham 7929 & Sutherland* (MICH, TRTE); Norfolk Twp., Turkey Point, uncommon on beach strand near marina, 18 Sep 1987, *Oldham 7914 & Sutherland* (DAO). **KENT CO.**: Harwich Twp., Rondeau Provincial Park, South Beach, single plant noted on sand beach, 22 Sep 1987, *Oldham 7958 & Hermanutz* (MICH). **LAMBTON CO.**: City of Sarnia, Canatara Park, locally common on moist pond edge, 10 Sep 1988, *Oldham 8717 & Delisle-Oldham* (DAO, MICH, TRTE, UWO); Bosanquet Twp., Kettle Point First Nation, common on moist shingle beach at edge of Lake Huron, 10 Sep 1988, *Oldham 8726 & Delisle-Oldham* (DAO, MICH). **MIDDLESEX CO.**: City of London, Meadowlily Woods, uncommon on moist ground along Thames River, 30 Aug 1988, *Oldham 8572 & McLeod* (CAN, DAO, MICH, OAC, TRTE, UWO, WAT); Lobo Twp., 2 km N of Komoka Post Office, rare and local on moist streambank of Oxbow Creek, 3 Oct 1989, *Oldham 10404 & McLeod* (DAO, MICH, UWO). **NIAGARA REGIONAL MUNICIPALITY**: Bertie Twp., Windmill Point, 9.4 km SSE of Stevensville Post Office, rare on Lake Erie beach strand, 13 Sep 1995, *Oldham 18197* (DAO); Fort Erie Twp., Point Abino, common on beach strand of Lake Erie, 17 Sep 1988, *Oldham 8781* (CAN, DAO, MICH, TRTE, UWO, WAT).

Dore and McNeill (1980) map this species from quite a few sites along the Ottawa and St. Lawrence Rivers and elsewhere in eastern Ontario, but not from the southwestern part of the province. Our collections, eleven sites in six counties, indicate that the species is quite widespread, although local, in the southwest. All but three of the southwestern Ontario collections come from the shores of Lake Erie or Lake Huron. One collection, from Sarnia, is from the edge of a small lake very near Lake Huron. Two collections are far inland, from the edge of the Thames River and one of its tributaries near London. All collections have come from natural shorelines, generally in moist, open, often sandy sites. As with *Panicum gattingeri*, this species has undoubtedly been overlooked due to its similarity to the very common and widespread *P. capillare*.

Paspalum ciliatifolium Michaux (Paspalum)

ELGIN CO.: Aldborough Twp., Hwy. 401, 3.6 km W of West Lorne, single colony in center

median of highway, 24 Aug 1990, *Oldham 11716* (DAO, MICH, UWO); Aldborough Twp., Eagle Woodlot, Lot 21, Conc. 11, several hundred fruiting culms in corner of mown pasture, 8 Sep 1990, *McLeod 90193* (DAO, MICH, UWO). **HALDIMAND-NORFOLK REGIONAL MUNICIPALITY**: Norfolk Twp., E side of Deer Creek, S of Regional Road 45, about 50 plants in open sandy clearing, 12 Sep 1985, *Bradley 1303* (TRTE); Nanticoke City Municipality, Hay Creek Conservation Area, one large clone on mesic, sandy southwest-facing slope with scattered mature Red Cedar and White Pine, 12 Sep 1986, *Sutherland 8001* (CAN, DAO, MICH, TRTE). **KENT CO.**: Howard Twp., Hwy. 21 at Hwy. 401, scarce in open, grassy area, 7 Sep 1988, *Oldham 8676* (DAO, MICH). **LAMBTON CO.**: Euphemia Twp., 3.8 km W of Newbury Post Office, abundant on roadside, 19 Sep 1987, *Oldham 7944* (DAO). **MIDDLESEX CO.**: Mosa Twp., 3.9 km SW of Newbury Post Office, McMaster Tract, several scattered plants in sandy soil of roadside at W entrance gate, 5 Sep 1986, *McLeod 86175* (DAO, MICH, UWO).

This grass was first found in Canada in Essex County, Ontario, in 1975, and in adjacent Kent County in 1976 (Crins et al. 1977). Reznicek (1984c) mapped this rare grass only from these two counties. Since 1984 the species has been found in four additional southwestern Ontario counties. At most sites it occurs in dry, sandy, open situations often with native associates (dry prairie species). At a few sites it occurs on roadsides with weedy associates where it may be adventive. This taxon is referred to *Paspalum setaceum* Michaux by some authors (Banks 1966, Gleason & Cronquist 1991).

\+ *Poa arida* Vasey (Plains Bluegrass)

ELGIN CO.: Aldborough Twp., Hwy. 401 just E of Kent County border, center median, 26 May 1986, *Oldham 6190* (DAO); Dunwich Twp., Hwy. 401 service center, 4.8 km WSW of Dutton Post Office, uncommon in moist saline ditch, 7 Jun 1989, *Oldham 9208* (DAO, UWO); South Dorchester Twp., Hwy. 73, 8.1 km NW of Springfield Post Office, single small clone on gravel roadside, 29 May 1990, *Oldham 10911* (DAO, MICH, UWO). **ESSEX CO.**: Rochester Twp., Hwy. 401 at St. Joachim Road exit, locally common in Hwy. 401 center median, 25 May 1986, *Oldham 6163* (DAO, MICH, TRTE). **HALTON REGIONAL MUNICIPALITY**: Milton, Hwy. 401 center median, 4 Jun 1988, *Oldham 8152* (DAO, TRTE). **HASTINGS CO.**: Thurlow Twp., westbound Hwy. 401 near Belleville, 26 May 1993, *Oldham sight record*. **KENT CO.**: Harwich Twp., Hwy. 401 at Hwy. 40 to Chatham, locally common in center median for *ca.* 10 km, 10 Jun 1990, *Oldham sight record*. **MIDDLESEX CO.**: City of London, Hwy. 401 at Wellington Road interchange, NE quadrant of highway cloverleaf, 2 m diameter patch in open, grassy saline area, 1 Jul 1985, *McLeod 85288* (DAO, UWO). **NORTHUMBERLAND CO.**: Brighton Twp., Hwy. 401, 2.0 km W of Hwy. 30 to Brighton, locally common in Hwy. 401 center median, 30 May 1986, *Oldham 6205 et al.* (DAO). **OXFORD CO.**: Blandford-Blenheim Twp., Hwy. 401, 1 km W of Nith River bridge, locally abundant in center median, 8 Jun 1986, *Oldham 6329* (DAO). **STORMONT, DUNDAS & GLENGARRY UNITED COUNTIES**: Hwy. 401 just W of Quebec border, locally abundant in hard clay soil in center median, from Quebec border W to Lancaster along Hwy. 401, 20 Jun 1987, *Darbyshire 3423A & Oldham* (CAN). **WELLINGTON CO.**: Puslinch Twp., median of Hwy. 401, 5.8 km E of Waterloo County line, 21 Jun 1980, *Catling s.n. & Catling* (DAO, MICH).

Catling and McKay (1980) first reported *Poa arida* in Ontario, on the basis of a 1979 collection from the median of Highway 401 in Oxford County. Reznicek (1980) reported it (as *P. glaucifolia*) new to Michigan based on a 1978 collection from a saline highway median, and Swink and Wilhelm (1994) discuss its distribution and habitat in the Chicago region where it was first found in

1991. In their review of halophytes in the eastern Great Lakes region, Catling and McKay (1981) consider it to be a species restricted to habitats with abnormally high sodium salt levels. Our observations support this, since virtually all of our collections and all of the several dozen additional sight records are from saline medians of the major east-west traffic artery in southern Ontario (Highway 401). Not only does this grass occur almost exclusively along Highway 401 (all the way from Essex County adjacent to Michigan in the west to the Quebec border in the east), but virtually all records are from the center median ditch, rather than ditches to the sides of the highway. The center median receives saline runoff (from de-icing salt) from both the east and westbound traffic lanes, rather than just one, and might be expected to be more saline than ditches running north or south of the highway.

Poa arida is locally very common along Highway 401, and we suspect it occurs in most, if not all, of the counties crossed by this highway between Michigan and Quebec. It was also collected in Quebec, at the Ontario border in the center median of Highway 20 (the extension of Highway 401 in Quebec) in 1987 (*Darbyshire 3423 & Oldham*, CAN). The species has not previously been reported from Quebec (Scoggan 1978). An early-flowering grass (May and early June in southern Ontario), it generally grows only in open, moist, and very saline areas, often with few other species. The most common associates, *Carex praegracilis* W. Boott and *Puccinellia distans* (Jacq.) Parl., are well known highway halophytes in the Great Lakes area (Reznicek et al. 1976, Catling & McKay 1980, Dore & McNeill 1980, Brunton & Catling 1982, Cusick 1982, Reznicek & Catling 1987, Garlitz 1992, Reznicek & Oldham 1993). Similar to *P. pratensis*, it can be distinguished by its denser panicle, larger size, blue-green, glaucous foliage, and tendency to grow in more obviously saline sites. This rhizomatous grass will run to *P. glauca* in the key by Dore and McNeill (1980).

Poa arida is native in prairies, plains, and alkaline flats in the western United States and Canada (Hitchcock 1951, Scoggan 1978), but in the east, it is not reported from Ohio (Braun 1967), Pennsylvania (Rhoads & Klein 1993), New England (Seymour 1982), and New York (Mitchell 1986, New York Flora Association 1990). It was, however, recently collected as an adventive from Ontario County, New York (*Catling 3122a* at DAO, MICH), and Hamilton County and Wayne County, Ohio (*Cusick 25,137* at MICH, and *Cusick 31,628 & Goodwin* at MICH). We suspect that *P. arida* is overlooked along major highways throughout the Great Lakes region and northeastern United States.

* *Poa bulbosa* L. (Bulbous Poa)

BRUCE CO.: Amabel Twp., Sauble Falls Provincial Park, locally common weed on sandy campsite, 18 Jun 1989, *Oldham 9404a & Delisle-Oldham* (CAN, DAO, MICH, TRTE, WAT). **ELGIN CO.**: Bayham Twp., Port Burwell Provincial Park, locally common weed on campsites, 2 May 1989, *Oldham 10611* (DAO, UWO); Malahide Twp., Aylmer, lawn weed in park, 15 Apr 1991, *McLeod 913* (DAO, UWO). **ESSEX CO.**: Mersea Twp., Point Pelee National Park, rare weed in sandy soil, 14 May 1983, *Oldham 3642 et al.* (DAO, MICH, TRTE). **HALDIMAND-NORFOLK REGIONAL MUNICIPALITY**: Norfolk Twp., Turkey Point Provincial Park, rare weed in sandy lawn in front of park office, 30 Apr 1991, *Oldham 12342 & Allen* (DAO, TRTE). **HALTON REGIONAL MUNICIPALITY**:

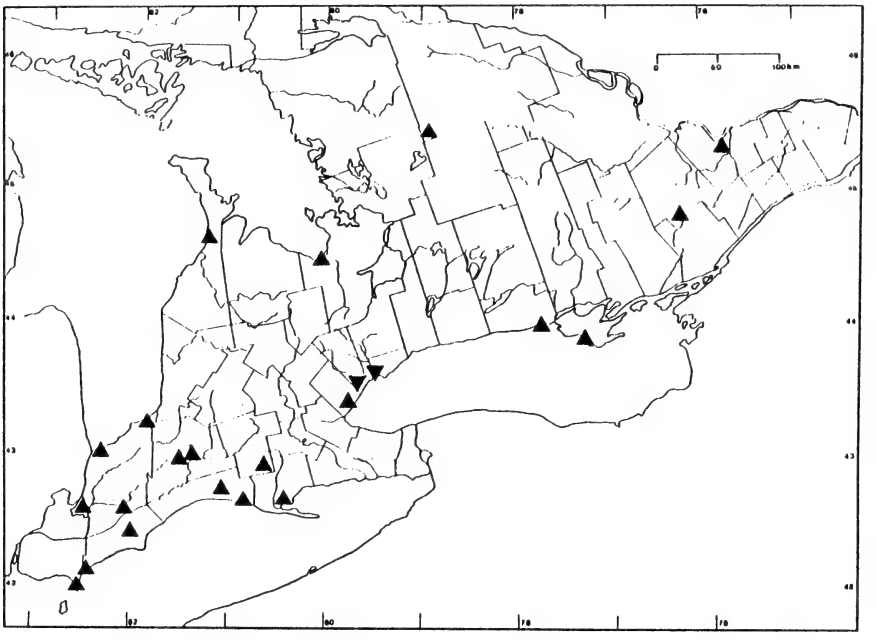

FIGURE 6. Distribution of *Poa bulbosa* in Ontario. Triangles (▲) represent specimens reported here, inverted triangles (▼) represent records from the literature (see text).

Oakville, Bronte Harbour Park, 24 May 1980, *Crins 2338* (TRTE); Burloak Waterfront, 11 Jun 1984, *Feth 16266* (TRTE). **KENT CO.**: Camden Twp., 6.7 road km E of Wabash on Hwy. 21, single plant on weedy residential lawn, 28 Apr 1990, *Oldham 10589 et al.* (DAO); Harwich Twp., Blenheim, common weed in cemetery, 4 May 1990, *Oldham 10633* (DAO, MICH, TRTE); Romney Twp., Wheatley Provincial Park, rare and local campsite weed, 16 May 1995, *Oldham 16965* (DAO). **LAMBTON CO.**: City of Sarnia, residential lawn, 28 May 1989, *Tiedje 5234* (UWO); Walpole Island First Nation, Seaway Island, single large clump in open waste area, 25 May 1985, *Oldham 4862 et al.* (DAO, MICH); Bosanquet Twp., Pinery Provincial Park, Burley Campground, scattered and uncommon on mesic, exposed sand of campsites, 7 Jun 1989, *Sutherland 8842* (DAO). **LANARK CO.**: North Burgess Twp., Murphy's Point Provincial Park, several clumps, in loose dry sand in mesic Sugar Maple/Beech woodland, 21 Jun 1984, *Sutherland 4953 & Gartshore* (TRTE). **MIDDLESEX CO.**: City of London, South Thames River between Wellington and Adelaide Streets, few plants in open lawn beside bicycle path, 23 May 1981, *McLeod 8128* (DAO, UWO); Delaware Twp., Kilworth, local at edge of sandy lawn, 12 May 1992, *Oldham 13658* (DAO). **NIPISSING DISTRICT**: Finlayson Twp., Algonquin Provincial Park, NW side of Hwy. 60, 1.1 km NE of West Gate, 1 Sep 1991, *Crins 8713* (APM). **NORTHUMBERLAND CO.**: Brighton Twp., Presqu'ile Provincial Park, Magpie Campground, rare weed in sandy campsites, 4 May 1995, *Oldham 16914* (DAO). **OTTAWA-CARLETON REGIONAL MUNICIPALITY**: Nepean, Lynwood Village, Cedarview Road, backyard lawn of S.G. Aiken, only one plant seen flowering, 20 May 1985, *Aiken & Darbyshire 2517* (CAN). **OXFORD CO.**: Norwich Twp., Otterville, locally common in recently seeded lawn, 20 May 1992, *Oldham 13685 & McLeod* (DAO). **PRINCE EDWARD CO.**: Athol Twp., Sandbanks Provincial Park, locally common weed on sandy campsites, 11 May 1995, *Oldham 16929*

(DAO, TRT). **SIMCOE CO.**: Sunnidale Twp., Wasaga Beach, rare and local on open disturbed roadside, 8 Jun 1995, *Oldham 17223 et al.* (DAO, MICH).

This easily overlooked European grass was first reported from Ontario by Catling et al. (1977) on the basis of collections from the Toronto area (Peel and York Regional Municipalities). Our collections add 15 southern Ontario counties (Figure 6) and indicate that the species is well established and spreading in the province. *Poa bulbosa* is distinctive owing to its proliferous spikelets and swollen plant base; however, it is small, early flowering, and frequently grows in lawns where periodic mowing makes it hard to detect.

Although a widespread weed in the western United States and British Columbia (Dore and McNeill 1980), it is currently rare and local in the east, where it may be establishing as a contaminant of commercial lawn grass seed. As in Ontario, the species appears to be spreading in Quebec (*Cayouette C7126*, DAO) and the eastern and central United States, on the basis of recent first reports from Michigan (Guala 1988), Vermont (Zika 1988), and Massachusetts (Grayum & Rohman 1986).

Poa sylvestris A. Gray (Bluegrass)

ESSEX CO: Pelee Twp., East Sister Island, uncommon and local in wet mesic to mesic mixed deciduous woods near east end of island, 22 May 1987, *Sutherland 8174 et al.* (DAO); Gosfield South Twp., Arner Spleenwort Woods, on N side of Huffman Sideroad, 5.3 km ESE of Harrow, rare and local in mesic to wet mesic sandy sugar maple, beech woodland, 23 May 1987, *Sutherland 8177* (DAO); Anderdon Twp., Canard River Scout Camp Woods, 10.2 km NE of Amherstburg Post Office, rare and local in rich woods, 15 Jun 1993, *Oldham 14958 et al.* (DAO). **KENT CO.**: Orford Twp., Clear Creek Woods, 2 km NW of Clearville, beech-maple upland woods, 5 Jul 1986, *Oldham 6451 et al.* (DAO). **MIDDLESEX CO.**: Mosa Twp., Sydenham River Corridor Carolinian Canada site, 5.8 km SSE of Alvinston Post Office, silty sand of mesic deciduous woods on river slope, 9 Jun 1992, *Bowles JB/SYD/92.059* (DAO, MICH, UWO).

Poa sylvestris was first collected in Canada at Rondeau Provincial Park in Kent County, Ontario, in 1975 (Reznicek 1984d). We have located this rare woodland grass at five additional sites in extreme southwestern Ontario, and agree with Reznicek (1984d) and Webber et al. (1985) that it is probably overlooked and confused with other *Poa* species, particularly the native woodland *P. alsodes*, with which it sometimes grows. *Poa sylvestris* has to date been found only in rich, relatively undisturbed deciduous forests, and is rare and local at all sites. Forests of this type have largely disappeared from southwestern Ontario, and it is possible that this species was once more common.

+ ***Puccinellia fasciculata* (Torrey) Bickn.** (Alkali Grass)

ELGIN CO.: Dunwich Twp., Hwy. 401 service center, 4.7 km WSW of Dutton Post Office, uncommon in moist, open, saline ditch, 26 Sep 1988, *Oldham 8826* (DAO, MICH, UWO).

Puccinellia fasciculata is common in salt marshes of the eastern seaboard, in saline habitats of western North America (Hitchcock 1951), and in Europe

(Tutin et al. 1979). This species, not previously reported from Ontario, is known in Canada from coastal areas of Nova Scotia and Prince Edward Island (Erskine 1960, Roland & Smith 1969, Scoggan 1978). The only previous inland report in eastern North America of which we are aware is that of House (1924), who reports it from Onondaga Lake in central New York, where it has not been reported since (Faust & Roberts 1983, New York Flora Association 1990). The Onondaga Lake area is well known for its concentrations of halophytes (Catling & McKay 1981, Faust & Roberts 1983) due to the large salt deposits.

The collection reported here is from a moist ditch adjacent to Highway 401 which receives saline runoff from the highway and an adjacent service center. Other adventive halophytes growing at this site included *Poa arida* Vasey, *Carex praegracilis* W. Boott, *Atriplex hastata* L., *Spergularia media* (L.) C. Presl ex Griseb., *Puccinellia distans* (Jacq.) Parl., *P. nuttalliana* (Schultes) A. Hitchc., and *Hordeum jubatum* L.

Puccinellia fasciculata may be distinguished from other *Puccinellia* species in the province by the dense inflorescence with the branches bearing spikelets to their bases.

+ *Puccinellia nuttalliana* (Schultes) A. Hitchc. (Goosegrass or Nuttall Alkali Grass)

COCHRANE DISTRICT: 14.3 km W of Shillington along Hwy. 101, gravel roadside, 29 Jun 1986, *Darbyshire 3070 & Aiken* (CAN). **ELGIN CO.**: Dunwich Twp., Hwy. 401 service center, 4.8 km WSW of Dutton Post Office, rare in moist saline ditch, 7 Jun 1989, *Oldham 9207* (DAO, MICH, UWO); South Dorchester Twp., Hwy. 73, 5.1 km NW of Springfield Post Office, small colony in roadside ditch, 14 Jul 1990, *Oldham 11360* (DAO, MICH). **FRONTENAC CO.**: Kingston, Hwy. 2, roadside, 1 Jul 1963, *Hainault 2638* (CAN). **HALTON REGIONAL MUNICIPALITY**: Milton Twp., Hwy. 401, 100 ft. E of Wellington County border, local in center median of Hwy. 401, 21 Jun 1987, *Oldham 7445* (DAO). **HASTINGS CO:** Tyendinaga Twp, Hwy. 401 at Hwy. 49, 1 km N of Marysville Post Office, rare and local in roadside ditch, 2 Aug 1993, *Oldham 15316* (DAO). **HURON CO.**: Goderich Twp., Goderich harbor, rare in weedy, waste area near salt mine, 6 Sep 1991, *Oldham 13422* (DAO). **KENT CO.**: Howard Twp., Hwy. 401 at Hwy. 21 interchange, roadside ditch, 20 Sep 1984, *Darbyshire 2441* (CAN). **MIDDLESEX CO.**: City of London, Hwy. 401 at Wellington Road interchange, damp, silty loam of open, saline ground in NW quadrant of cloverleaf, 19 Jun 1985, *McLeod 85203* (DAO, UWO); North Dorchester Twp., Hwy. 401 at Hwy. 73, uncommon in highway interchange, 21 Jun 1988, *Oldham 8273* (DAO, UWO). **OXFORD CO.**: City of Woodstock, Hwy. 401, 1.3 km WSW of Hwy. 59 junction, single extensive colony in center median, 14 Jul 1993, *Oldham 15154* (DAO). **PETERBOROUGH CO.**: City of Peterborough, Hwy. 7 (by-pass) S of Peterborough, uncommon and local in saline highway center median, 18 Aug 1990, *Oldham 11675b & Sutherland* (DAO). **SIMCOE CO.**: Orillia Twp., median of Hwy. 11, *ca.* 0.5 km S of Hwy. 12B turnoff to Orillia, 28 Jun 1980, *Catling s.n. & Catling* (DAO, MICH). **THUNDER BAY DISTRICT**: Bomby Twp., 2 km W of Cigar Lake, 34 road km E of Marathon, local on roadside, scattered for several km, 9 Jul 1989, *Oldham 9673 & Delisle-Oldham* (DAO, MICH); Dawson Road Lots, Shabaqua Corners, junction of Hwys. 11 and 17, locally common on roadside and adjacent ditches, 9 Aug 1995, *Oldham 18011 & Bakowsky* (DAO, LKHD); Dorion Twp., Hwy. 17, 2 km SW of Dorion, roadside, 10 Jul 1989, *Oldham 9703 & Delisle-Oldham* (DAO); Lecours Twp., Hwy. 17, 7.5 km E of Black River bridge, uncommon in moist roadside ditch, 3 Aug 1995, *Oldham 17681 & Bakowsky* (DAO, LKHD). **TIMISKAMING DISTRICT**: Harley Twp., 9 miles N of New Liskeard on Hwy. 11, edge of highway in gravel of shoulder, 29 Jun 1986, *Darbyshire 3078 & Aiken* (CAN).

Puccinellia nuttalliana is widespread in western North America in moist prairies, saline shores and alkaline flats (Hitchcock 1951, Scoggan 1978). In the east, Hitchcock (1951) reports it as introduced in Maine and Vermont. It is reported from New York, where Mitchell (1986) considers it a native species, but presumed extirpated. There are no confirmed reports from Michigan (Voss 1972, Garlitz 1992) or Ohio (Braun 1967). Dore and McNeill (1980) map *P. nuttalliana* at two Ontario sites: Ingolf, Kenora District, and Longlac, Thunder Bay District. They suggest that the former site may represent the eastern limit of an extensive native range in saline areas of the western prairies, but that at the latter site it is introduced along a railway. All collections reported here are from roadsides.

Although considerably rarer than *Puccinellia distans*, our records indicate that *P. nuttalliana* is more widespread than previously thought (Figure 7) and probably spreading along roadsides in a manner similar to other halophytes. Because of the similarity between these two *Puccinellia* species, and the abundance of *P. distans* along southern Ontario roadsides, we expect that *P. nuttalliana* has been overlooked. In the field, *P. nuttalliana* can be distinguished by its larger size and more diffuse inflorescence.

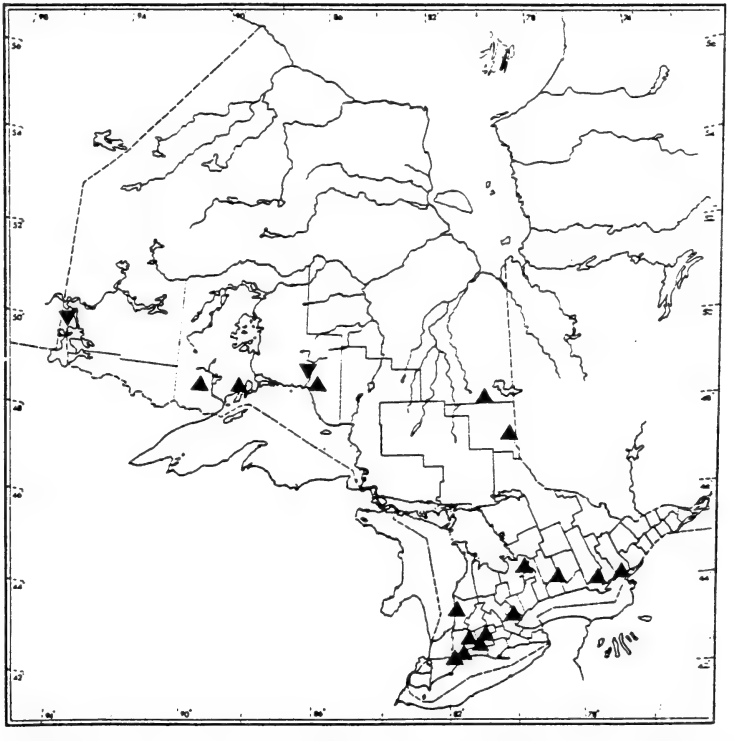

FIGURE 7. Distribution of *Puccinellia nuttalliana* in Ontario. Triangles (▲) represent specimens reported here, inverted triangles (▼) represent records from the literature (see text).

Sporobolus heterolepis (A. Gray) A. Gray (Northern or Prairie Dropseed)

BRANT CO.: City of Brantford, 3.5 km NW of Brantford Post Office along Erie & Northern (C.P.) railway, several robust clumps on dry sandy ground, 18 Aug 1990, *Oldham 11681 & Sutherland* (DAO, MICH, TRTE). **HASTINGS CO.**: Thurlow Twp., Point Anne, east of Belleville on Bay of Quinte, large patch in alvar opening, 5 Sep 1987, *Darbyshire 3612 et al.* (CAN, DAO); Sidney Twp., New Overlook Prairie opening, frequent, open, sandy-gravel, 16 Aug 1991, *Catling 9925 & Catling* (DAO); Tyendinaga Twp., Deseronto Alvar, E side of Marysville Road, 2.5 km W of Deseronto, open, shallow soil over limestone, 28 Aug 1992, *Catling 13531 & Catling* (DAO). **LANARK CO.**: Ramsay Twp., 4 km NW of Hwy. 44, 200 m W of Conc. 12, open dry alvar meadow, 8 Aug 1985, *Brunton 6201* (DAO). **MUSKOKA DISTRICT**: Town of Gravenhurst, Lion's Head, along Severn River, 1.7 km E of Morrison Landing, locally common on barren, gneissic rock slope along shoreline, 5 Sep 1991, *Sutherland 9369 & Kamstra* (DAO).

Reznicek (1984e) maps this rare native grass mainly from limestone plains on the Bruce Peninsula, Manitoulin Island, along the Ottawa River in eastern Ontario, and some eastern Ontario alvars. Two old collections are also plotted from near the north shore of Lake Ontario, where the species was last collected in the late 1800's. The Brant County collection is more than two hundred kilometers south and west of the nearest previous Ontario records. The Muskoka District record is the first from the east side of Georgian Bay, and the three Hastings County collections indicate that the species still occurs in the eastern Lake Ontario region. Although a widespread prairie species (Hitchcock 1951), *Sporobolus heterolepis* is very local eastward. In Ontario this species tends to occur in undisturbed prairie and alvar habitats, frequently with other rare native plants.

\+ *Tridens flavus* (L.) Hitchc. (Purpletop)

ESSEX CO.: City of Windsor, Titcombe Field, 10 Sep 1979, *Botham 2219* (CAN). **HALDIMAND-NORFOLK REGIONAL MUNICIPALITY**: Norfolk Twp., 2.1 km SE of Tillsonburg Post Office along Canadian Pacific railway line, a few clumps in sandy soil along tracks, 21 Sep 1990, *Oldham 12000* (DAO, MICH).

The first collection of this grass in Canada was from a railway yard in Niagara Falls in 1976 (Catling et al. 1977). Although the species is widespread in the eastern and midwestern United States (Hitchcock 1951), Catling et al. (1977) state that it may have been native in the Niagara Peninsula. Known sites are either from railway beds or roadsides, and we suspect that the species is adventive here. Zika (1990) reported that *Tridens flavus* was spreading northward in New Hampshire and Vermont.

* ***Vulpia myuros* (L.) C. Gmelin** (Foxtail Fescue)

ESSEX CO.: City of Windsor, local weed in Assumption Cemetery, 11 Jun 1990, *Oldham 11028* (DAO, MICH, TRTE, WAT). **KENT CO.**: Dover Twp., St. Clair National Wildlife Area, Lake St. Clair, rare and local on sandy dyke, 7 June 1987, *Oldham 7294* (DAO, MICH).

Native to Eurasia, this small annual grass occurs as a common weed throughout temperate and subtropical regions of the world (Lonard & Gould 1974). In North America it is most common in coastal regions. Although it is common in southwestern British Columbia (Scoggan 1978), no previous records exist for Ontario. *Vulpia myuros* has yet to be reported from Minnesota (Ownbey & Morley 1991) or Ohio (Braun 1967). Swink and Wilhelm (1994) report it as a rare weed in the Chicago region where it was first collected in 1973, and there is a 1976 collection from Berrien County, Michigan (*Kohring 10-76* at MSC).

Both reported populations were small and localized, flowering early and very inconspicuous after mid-June. We expect that additional localities will be discovered for this species in the province. *Vulpia myuros* can be distinguished from the native *V. octoflora* by its very unequal glumes.

ACKNOWLEDGEMENTS

We would like to thank A. A. Reznicek for encouragement and assistance with specimen identification. W. J. Cody allowed us to report his specimen of *Festuca gigantea*, and W. B. Draper allowed us to cite his *Diarrhena obovata* collection. P. W. Ball and J. B. Phipps provided working space and assistance at TRTE and UWO, respectively. A. A. Reznicek, W. J. Crins, P. M. Catling, R. K. Rabeler, S. N. Stephenson, and A. W. Cusick commented on earlier drafts of the manuscript. The Ontario Ministry of Natural Resources and Agriculture and Agri-Food Canada contributed financially to the publication of this paper.

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ANNOUNCEMENT

CONFERENCE
NATURAL AREAS IN URBAN SETTINGS

The 23rd Natural Areas Conference will be held in St. Charles, Illinois (just west of Chicago) from October 12–26. If you are not a member of the Natural Areas Association and would like to be on the mailing list for the 23rd Annual Conference, send a note to:

Natural Areas Association
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Chesterfield, MO 63006-0900

THE BIG TREES OF MICHIGAN
9. Ginkgo biloba L.

Matthew E. Spletzer and Elwood B. Ehrle
Dept. of Biological Sciences
Western Michigan University
Kalamazoo, MI 49008

Paul W. Thompson[1]
Cranbrook Institute of Science
Bloomfield Hills, MI 48013

The largest known maidenhair tree in Michigan is located in the city of Hillsdale in Hillsdale County of Michigan's Lower Peninsula.

Description of the species: Ginkgo biloba is the only living species of its genus, family and order (Cronquist, 1988). *Ginkgo* is distinguished from other trees by its leaves, which are simple, deciduous, dichotomously veined, and fan-shaped (Fig. 1). The species is dioecious, and the female *Ginkgo* produces naked, paired ovules (Woodland, 1991). Although it is widely grown as an ornamental in temperate regions, it is not known to occur in the wild. Males are usually planted as ornamentals, because the fleshy covering of the mature seeds has a strong unpleasant smell. Michigan's Big Tree, however, is a female.

Location of Michigan's Big Tree: Michigan's largest maidenhair tree is located at the corner of McCollum and Manning Streets in downtown Hillsdale, Michigan. At this intersection, the tree can easily be seen at the southeast corner of the purple, two-story Mitchell Public Library. There is an aluminum Michigan Botanical Club sign on the east side of the tree indicating its State Champion status.

Description of Michigan's Big Tree: The tree has a single solid, healthy trunk with two large burls on its west side. There is no visible disease or storm damage. The circumference of the tree at breast height was measured on November 6, 1993 at 147″ (373 cm) [Diameter = 47″ (119 cm)]. The crown spread was measured at 60′ (18 m), a 10% decrease in crown spread from that reported by Thompson (1986). The crown radii were 26, 25, 32, and 36′. The crown has been pruned on its northwest side adjacent to the library building. The tree's height was measured at 80′, a reduction of 15% from the 94′ reported by Thompson (1986). The lowest branch is 8′6″ from the ground.

INVITATION TO PARTICIPATE

If you would like to join us in extending this series of articles by visiting and describing one or more of Michigan's Big Trees, please contact Elwood B. Ehrle for help with locations, specifications for taking measurements, and assistance with the manuscript. The Michigan Botanical Club encourages your

[1]Deceased 20 September 1994.

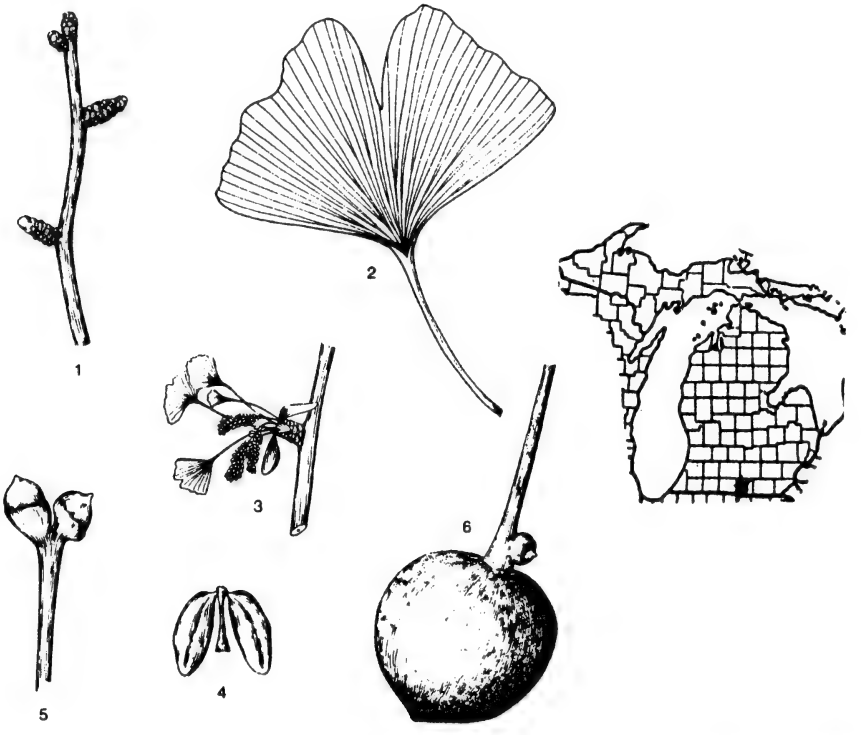

FIGURE 1. Characteristics of *Ginkgo biloba* L. and map showing location of Michigan's Big Tree. Illustrations are from Barnes & Wagner (1981). 1. Winter twig with short shoots, ×1/2; 2. Leaf, ×1/2; 3. Pollen-bearing twig, ×1/2; 4. Pollen sacs, enlarged; 5. Unfertilized seed twig, enlarged; 6. Mature fleshy seed, ×1.

involvement in this activity. Please remember to ask permission before entering private property.

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ANNOUNCEMENT

SYMPOSIUM

THE ROLE OF MYCORRHIZAL FUNGI IN RESTORATION ECOLOGY OCTOBER 22, 1996

The Chicago Botanic Garden presents the first annual Janet Meakin Poor Research Symposium, entitled "The role of mycorrhizal fungi in restoration ecology." The conference will be held on Tuesday, October 22, 1996, from 8:30 a.m. to 3:45 p.m. in the Alsdorf Auditorium at the Garden. Topics of the symposium include the ways in which mycorrhizal fungi influence diversity in prairie restorations, the role mycorrhizae play in the restoration of soil structure, and the challenges of raising mycorrhizal plants in a nursery. Speakers at the symposium will include Drs. Julie Jastrow and Mike Miller of Argonne National Laboratory in Illinois, Greg Mueller of the Field Museum of Natural History in Chicago, Ted St. John of Tree of Life Nursery in California, and Larry Zettler of Furman University in South Carolina.

Fees for the program are $59 for members of the Chicago Horticultural Society and $74 for nonmembers. Those interested can register by mail to the address below, by phone to the Education Registrar at (847) 835-8261, or in person. For more information, call the Education Registrar.

This program is partially funded by the Janet Meakin Poor Research Symposium Endowment Fund.

Chicago Botanic Garden
P.O. Box 400
Glencoe, IL 60022

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On the cover: *Dwarf lake iris (*Iris lacustris*). Drawing by Harvey E. Ballard, Jr.*

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THE MICHIGAN BOTANIST

October, 1995

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The following issues are available only in complete sets or in sets beginning with Vol. 2 (marked as *): 1(1, 2 – all published), 2(1*, 4*), 4(3*), 5(1*, 2*, 3*), 7(4*), 9(3*), 19(3), and 26(3).

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Articles dealing with any phase of botany relating to the Great Lakes Region may be sent to the Editor. In preparing manuscripts, authors are requested to follow our style and the suggestions in "Information for Authors" (Vol. 28, p. 43; Vol. 29, p. 143).

THE MICHIGAN BOTANICAL CLUB

Membership in the Michigan Botanical Club is open to anyone interested in its aims: conservation of all native plants; education of the public to appreciate and preserve plant life; sponsorship of research and publication on the plant life of the State; sponsorship of legislation to promote the preservation of Michigan native flora; establishment suitable sanctuaries and natural areas; and cooperation in programs concerned with the wise use and conservation of all natural resources and scenic features.

Dues are modest, but vary slightly among the chapters and with different classes of membership. Persons desiring to become state members (not affiliated with a local chapter, for which contact persons are listed below), may send $17.00 dues to the Membership Chairperson listed below. In all cases, dues include a subscription to *THE MICHIGAN BOTANIST*. (Institutions desiring to subscribe should deal directly with the Business and Circulation Manager.) Foreign subscribers should remit in U.S. funds.

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NEW COMBINATIONS IN THE MICHIGAN FLORA

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A few new combinations are necessary in order to recognize certain variants at what I believe to be an appropriate rank and position in the forthcoming *Michigan Flora* Part III. Note that these are variants for which names already exist, but in other combinations. I refrain from publishing new names for any such minor expressions of variation.

Bidens connatus f. **anomalus** (Farwell) E. G. Voss, comb. nov.

B. connatus var. *anomalus* Farwell, Ann. Rep. Comm. Parks, Blvds. Detroit 11: 91. 1900.

Anomalous plants with the barbs on the awns of the achene antrorse rather than (as usual) retrorse occur throughout the range of this species and would seem best recognized, if at all, at the rank of form.

Bidens connatus f. **ambiversus** (Fassett) E. G. Voss, comb. nov.

B. connatus var. *ambiversus* Fassett, Rhodora 30: 33. 1928.

Plants with barbs on the awns both antrorse and retrorse are likewise unworthy of varietal rank.

Cirsium hillii f. **albiflorum** (Scoggan) E. G. Voss, comb. nov.

C. pumilum f. *albiflorum* Scoggan, Fl. Canada 1: 52. 1978. ≡ *C. pumilum* f. *candidum* B. Boivin, nom. illeg. (Nat. Canad. 94: 646. 1972) non *C. pumilum* f. *candidum* Fernald (Rhodora 45: 354. 1943).

Fernald's name applies to the white-flowered form of *C. pumilum* sens. str. (var. *pumilum*); the names of Boivin and Scoggan, to the white-flowered form of *C. hillii* or *C. pumilum* var. *hillii*.

Liatris scariosa var. **nieuwlandii** (Lunell) E. G. Voss, comb. nov.

Laciniaria scariosa var. *nieuwlandii* Lunell, Am. Midl. Nat. 2: 176. 1912.

Typical *L. scariosa* occurs in the Southeast and has fewer, less crowded leaves on the stem. Inland plants, such as are locally common on the jack pine plains of Michigan, have been variously treated as a hybrid of uncertain parentage or as a variety of one or another species. Although the present combination has been attributed to Lunell in some recent works (e.g., Gleason & Cronquist 1991; Kartesz 1994), indicating a certain amount of current agreement on appropriate rank and position, I do not find that it was ever published by Lunell (or anyone else), and it is not included in the standard indices to new names (e.g., Gray Herbarium Card Index; Index Kewensis).

LITERATURE CITED

Gleason, H. A., & A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. 2nd ed. New York Bot. Gard., New York. lxxv + 910 pp.

Kartesz, J. T. 1994. A Synonymized Checklist of the Vascular Flora of the United States, Canada, and Greenland. 2nd ed. Timber Press, Portland, Oregon. 2 vol.

EDITORIAL NOTICE

Most of this issue consists of our (more-or-less) regular three-year index. The compilation of an index is a painstaking and usually thankless task, for which (fortunately for *The Michigan Botanist*) Neil Harriman has once again cheerfully volunteered. I want to thank Neil for his hard work, not only on the index itself, but also on the chicken-and-egg balancing act of fitting papers into this issue and simultaneously getting them indexed. In addition, Neil serves as book review editor and as a regular reviewer; he's one of the selfless people without whom this journal could not be produced.

THE BIG TREES OF MICHIGAN
10. Tilia americana L.

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The State Champion American Linden or Basswood is located in Ingham County, SE of Dansville, MI in section 1 of T1N, R2E. It is among the largest of the species in the United States.

Description of the species: The Basswood is the only native species of the family Tiliaceae found in the United States. The most conspicuous characteristic of the leaf of the basswood is that the leaf bases are oblique or asymmetric in their attachment to the petiole (Fig. 1). The leaves are generally cordate (heart-shaped) and toothed on the margins. The undersides of the leaves are slightly paler than the upper surface. Another conspicuous characteristic is the presence of a vegetative bract that subtends the peduncle of the inflorescence. The bract frequently has three or more seeds attached to it, creating an appearance reminiscent of the balls of a pawn broker's sign. The flowers bloom in June or July after the leaves are completely expanded. Each flower has five downy sepals and five white petals, and is quite fragrant.

Basswoods are found naturally in many different communities and habitats. These communities range from mesic forest to wetter areas like floodplains and bottomland forest (Barnes & Wagner 1981, Kricher 1988). Other woody plants associated with the Basswood in these habitats are: Maples, *Acer* sp.; Hackberry, *Celtis occidentalis*; American Elm, *Ulmus americana*; and Poison Ivy, *Toxicodendron radicans* (Curtis 1959).

Location of Michigan's Big Tree: The State Champion Basswood is located along the south side of M-36 in Ingham County, west of Plainfield on M-36 and 165 feet (50.3 m) east of Kinsy Road. The tree is only 18 feet from the pavement of M-36 and is easily spotted. At one time, this basswood was in the front yard of an old farm house and the driveway is approximately 5 feet from exposed roots. Apparently, this state champion tree was originally in a fence row. The basswood is still in line with two very large Sugar Maples (*Acer saccharum*).

Description of Michigan's Big Tree: The trunk of this tree is hollow. The large amount of guano located at the base of the hollow portion of the trunk indicates that it may be inhabited by a colony of bats. The diameter of the trunk at breast height is 88″ (223.5 cm) and the circumference is 275″ (698.5 cm). The tree is showing other signs of decline. Thompson (1986) reported that the

[1]Deceased 20 September 1994.

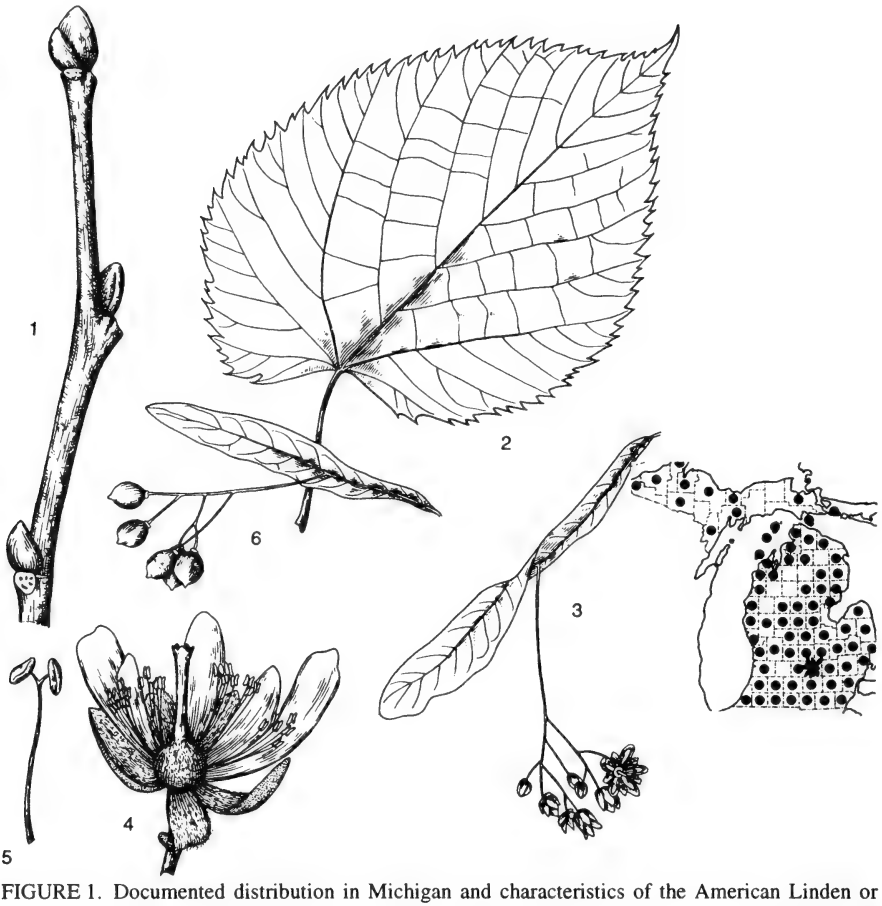

FIGURE 1. Documented distribution in Michigan and characteristics of the American Linden or Basswood. Map is from Voss (1985). The star indicates the location of Michigan's Big Tree. Drawings are from Barnes & Wagner (1981). 1. Winter Twig, ×1; 2. Leaf, ×1/2; 3. Bract with cluster of flowers, × 1/2; 4. Flower, partially dissected to show parts, enlarged; 5. Stamen, enlarged; 6. Bract bearing cluster of fruit.

height of this tree was 78′ (23.8 m). It was measured on October 16, 1993 at only 57′ (17.4 m) high. Likewise, the crown spread has also declined significantly. Thompson (1986) reported the tree had a crown spread of 99′ (30.2 m) and in 1993, it had a crown spread of only 68′ (20.7 m). The crown radii are 6′, 39.5′, 46′, and 25.75′. Voucher specimens are being prepared for deposition in the herbaria at the University of Michigan (MICH), Michigan State University (MSU), and Western Michigan University (WMU).

Even with these losses, this tree continues to be the State Champion tree because State Champion status is based on girth alone. This tree has been

reported (Thompson 1983) as being the National Champion Tree. However, since then, other bigger trees of this species have been found. Presently, there are co-champion basswoods in the United States. They are found in Hamilton County, Ohio and in Montgomery County, Pennsylvania (Whittier 1994).

INVITATION TO PARTICIPATE

If you would like to join us in extending this series of articles by visiting and describing one or more of Michigan's Big Trees, please contact Elwood B. Ehrle for help with locations, specifications for taking measurements, and assistance with the manuscript. The Michigan Botanical Club encourages your involvement in this activity. Please remember to ask permission before entering private property.

LITERATURE CITED

Barnes, B. V., and W. H. Wagner, Jr. 1981. Michigan Trees. A Guide to the Trees of Michigan and the Great Lakes Region. Univ. Michigan Press, Ann Arbor. viii + 383 pp.

Curtis, J. T. 1959. The Vegetation of Wisconsin: An Ordination of Plant Communities. Univ. Wisconsin Press. Madison, WI. xiv + 657 pp.

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Whittier, J. G. 1994. National Register of Big Trees, 1994 Edition. American Forests 100: 1–48.

THE BIG TREES OF MICHIGAN
11. Fraxinus pennsylvanica L.

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Michigan's largest known Red Ash is in Cass County, approximately 3 miles northwest of the town of Dowagiac in southwest lower Michigan.

Description of the Species: The genus *Fraxinus* (Ash) in the family Oleaceae (Olive Family) has as related genera the cultivated ornamental shrubs *Syringa* (Lilacs), *Ligustrum* (Privet), and *Forsythia*. There are 12 North American species of ash, of which four are native to Michigan: *F. americana* L. (White Ash), *F. nigra* Marsh. (Black Ash), *F. quadrangulata* Michx. (Blue Ash), and *F. pennsylvanica* Marsh. (Red Ash) (Barnes & Wagner 1991). Ashes differ from most trees by having opposite, pinnately-compound leaves of 5-11 leaflets, and fruits that are prominently winged, single samaras (see Fig. 1).

Red Ash, typically found in wet mesic uplands or periodically-wet sites like floodplains, has a number of distinguishing field characteristics. The leaves, 25-30 cm in length, are comprised of 7-9 short-petioled leaflets, 7-13 cm in length and 2.5-4.5 cm in width, which are oblong-lanceolate to ovate in shape (Barnes & Wagner 1991). After the leaves fall, a raised leaf scar remains. The fruit displays a narrow, slender wing that does not extend to the base of the seed, the free part being about equal to the body itself. The fruit persists through winter to the following spring. The twigs (round in cross section) and petioles of Red Ash are usually densely pubescent, and in the spring of the year are red in color, particularly in the crown. Gleason and Cronquist (1991) identify two varieties of *F. pennsylvanica*—red (var. *pennsylvanica*) and green (var. *subintegerrima* (Vahl) Fern), though they note that these varieties "are probably not taxonomically significant." The red variety, found predominantly in southeastern Michigan, has pubescent twigs whose surface flakes off when rubbed, whereas the green variety has glabrous twigs and is found principally in the western part of the state.

Location of Michigan's Big Tree: The State Champion Red Ash can be reached by turning north on Garrett Rd. off of M-62, the major highway connecting Dowagiac and Eau Clair. Garrett Rd. is 3.2 miles west of the town limits

[1]Deceased 20 September 1994.

FIGURE 1. Characteristics of the Red Ash. Drawings are from Barnes & Wagner (1991). 1. Winter Twig, ×1; 2. Leaf, ×1/3; 3. Male flowering twig, ×1/2; 4. Male flower, enlarged; 5. Female flowering twig, ×1/2; 6. Female flower, enlarged; 7. Fruit, samara, ×1.

of Dowagiac. After running north for nearly two miles, Garret Road turns east into Burk for nearly a mile, then turns north again, eventually becoming Townhall Road. The tree stands on the southwest corner of the intersection of Townhall and Topash (that is, the 31,000 block of Townhall and the 52,000 block of Topash). The intersection is just 2 miles north of Burk and 1.4 miles north of Middle Crossing Road.

Description of Michigan's Big Tree: This tree is quite symmetrical, with a height of 95' (29 m) and an average crown spread of 95′ (29 m) diameter. Its trunk is healthy with only minor scarring on the east side (apparently lightning damage). The circumference of the trunk has increased by 17″ (43 cm) in the 10 years since being measured by Thompson (1986), now measuring 259" (6.6 m).

Two large branches, each well over 2′ (61 cm) in diameter, emerge from the trunk, the first at 8′ (2.4 m) above the ground and the second just slightly higher. The trunk then divides into two main sections that terminate in the uppermost branching.

Standing at the end of a row of Red Ashes bordering Topash Road, this champion tree grows in a rural environment with cultivated and pasture land all around and only distant farmhouses, the nearest perhaps a quarter miles away. On three sides, the south, west, and north, the land slopes down toward the tree giving it some protection from the prevailing winds.

Voucher specimens of this tree are being prepared for filing in the Hanes Herbarium (WMU) and the herbaria at Michigan State University (MSC) and the University of Michigan (MICH).

INVITATION TO PARTICIPATE

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Thompson, P. W. 1986. Champion trees of Michigan. Michigan Bot. 25:112-118.

THE BIG TREES OF MICHIGAN
12. Morus rubra L.

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Michigan's largest known Red Mulberry is in Berrien County on the eastern edge of the town of Bridgman in southwest lower Michigan.

Description of the Species: The northeastern North American Moraceae, or Mulberry Family, contains three genera: *Maclura* (Osage Orange), *Broussonetia* (Paper Mulberry), and *Morus* (Mulberry) (Gleason & Cronquist 1991). All have alternate leaves and milky juice, and produce multiple fruit with a warty or faceted appearance, derived from a single inflorescence.

There are two species of mulberry in Michigan, red and white. *M. rubra* L. (Red Mulberry) can be distinguished from *M. alba* L. (White Mulberry) by the hairiness (pubescence) of its lower leaf surfaces. *M. alba* has smooth lower leaf surfaces (glabrous), or the lower leaf surfaces are hairy only along the major veins.

Red Mulberry, found principally on floodplains and river bottoms (Voss 1985), has variously lobed (especially on young, actively growing trees) or simple leaves on the same plant. The leaves have coarsely serrate margins and are sharply acuminate (See Fig. 1). The upper leaf surfaces are glabrous or rough; the lower leaf surfaces are covered with fine hairs. The bark of the tree is dark brown, tinged with red or yellow, and separates into flaking plates. The fruit is 2-2.5 cm long, red at first and becoming purple-black, sweet, juicy and edible (Barnes & Wagner 1991).

Location of Michigan's Big Tree: The town of Bridgman is located near exit #16 of Interstate highway 94 between St. Joseph and the Michigan state line. From the stoplight on the Blue Star Highway in Bridgman, turn east on Shawnee and proceed 1.6 miles to Jerico Road. The Michigan Tree is located on the northeast corner of the intersection of Jerico and Shawnee roads.

Description of Michigan's Big Tree: Having once enjoyed the status of being a National Champion with a girth of 224″ (5.7 m) (Thompson 1986), this Michigan Big Tree has been reduced considerably by the loss of one of its four

[1]Deceased 20 September 1994.

FIGURE 1. Documented distribution in Michigan and characteristics of the Red Mulberry. Map is from Voss (1985). The star indicates the location of Michigan's Big Tree. Drawings are from Barnes & Wagner (1991). 1. Winter twig, ×1; 2. Portion of twig, enlarged; 3. Leaf, lobed, ×1; 4. Leaf, unlobed, ×1/2; 5. Catkin of male flowers, ×1; 6. Male flower, enlarged; 7. Catkin of female flowers, ×1; 8. Female flowers, enlarged; 9. Fruit, multiple of drupes, ×1.

main trunks. With the three remaining trunks, its girth now measures 174″ (4.4 m). Much of the center of the trunk is hollow, with three trunks dividing at about 6' above the ground. The missing trunk was cut off 3′ (.9 m) above the ground. Three sucker sprouts emerge from the edge of the cut surface (one about 4″ (10 cm) in diameter and the other two only half as large) and big rocks have been stuffed into the hollow center of the main trunk. The crown spread averages 49′ (15 m) in diameter and the topmost branches end 56′ (17 m) above the street.

This Michigan tree has not been well cared for and shows signs of disease and damage. Perhaps nearby development has contributed to its deterioration. It

stands in the front yard of a home in need of upkeep. Only a car length away, Shawnee Road is a busy thoroughfare.

Voucher specimens of this tree are being prepared for filing in the Hanes Herbarium (WMU), and the herbaria at Michigan State University (MSC) and the University of Michigan (MICH).

INVITATION TO PARTICIPATE

If you would like to join us in extending this series of articles by visiting and describing one or more of Michigan's Big Trees, please contact Elwood B. Ehrle for help with locations, specifications for taking measurements, and assistance with the manuscript. The Michigan Botanical Club encourages your involvement in this activity. Please remember to ask permission before entering private property.

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ANNOUNCEMENT

A REVISION OF H.A. GLEASON'S PLANTS OF MICHIGAN, BY RICHARD K. RABELER

This concise field guide contains illustrated keys to Michigan plant families, and keys to species known to grow in Michigan (excluding such cases as species reported once but never seen again in the state). It is thus an excellent and compact complement to Edward Voss' complete three-volume *Michigan Flora. Plants of Michigan* also contains an index to plant names, a glossary, notes on special topics, and a preface on Henry Gleason and his contribution to Michigan botany. Publication is expected in late 1996, and a prepublication discount may be obtained by writing to: George Wahr Publishing Company, 304 ½ S. State Street, Ann Arbor, MI 48104.

INDEX TO VOLUMES 32, 33, AND 34

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This index follows the general format and philosophy of previous indexes. Scientific names are cited for *every* occurrence on every page, including figure legends and within the body of tables, but not literature citations at the ends of papers. Common names are not indexed. A full citation of authors and title is only given for the first author; citation for all other authors is given by a reference to the first author. Names written with an indication of hybrid origin, like *Viola* ×*sublanceolata,* are nomenclaturally equivalent to the same binomial without the symbol for hybrid origin; therefore, when the binomial appeared both ways in the various pages of these volumes, the listings have been combined.

EDITORIAL NOTICE: INDEX TO INDICES

I pass on the following from Thomas Clough, the Business and Circulation Manager:

A deficiency in the indexing system has been brought to my attention a couple of times by subscribers trying to do research: there's no "Index to Indices." Since, historically, indices have not always been issued every three volumes, for people wanting to use *The Michigan Botanist* for those purposes, there's no quick way to find possibly relevant articles.

Accordingly, I suggest the following table be included (and updated) in all issues containing an index:

INDEX TO INDICES

Index in:			Includes:		
Vol.	3,	#4	Vols.	1	- 3
Vol.	6,	#4	Vols.	4	- 6
Vol.	9,	#4	Vols.	7	- 9
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Vol.	31,	#4	Vols.	29	- 31
Vol.	34,	#4	Vols.	32	- 34

An excellent suggestion, herewith implemented. ———Barbara J. Madsen

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3. Be sure to furnish all information called for in item 15, regarding circulation. Free circulation must be shown in items 15d, e, and f.
4. If the publication had second-class authorization as a general or requester publication, this Statement of Ownership, Management, and Circulation must be published; it must be printed in any issue in October or the first printed issue after October, if the publication is not published during October.
5. In item 16, indicate date of the issue in which this Statement of Ownership will be printed.
6. Item 17 must be signed.

Failure to file or publish a statement of ownership may lead to suspension of second-class authorization.

PS Form **3526,** October 1994 *(Reverse)*

CONTENTS

On the cover: *Snowberry* (Gaultheria hispidula).
Photographed by Howard Crum.